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Pentland

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(54) **FALLING PATTERN IMAGERY SYSTEM**

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G09F 19/02 (2006.01)

(52) **U.S. Cl.**
CPC ***G09F 19/02*** (2013.01)

(58) **Field of Classification Search**
CPC G09F 19/02
USPC 40/409
See application file for complete search history.

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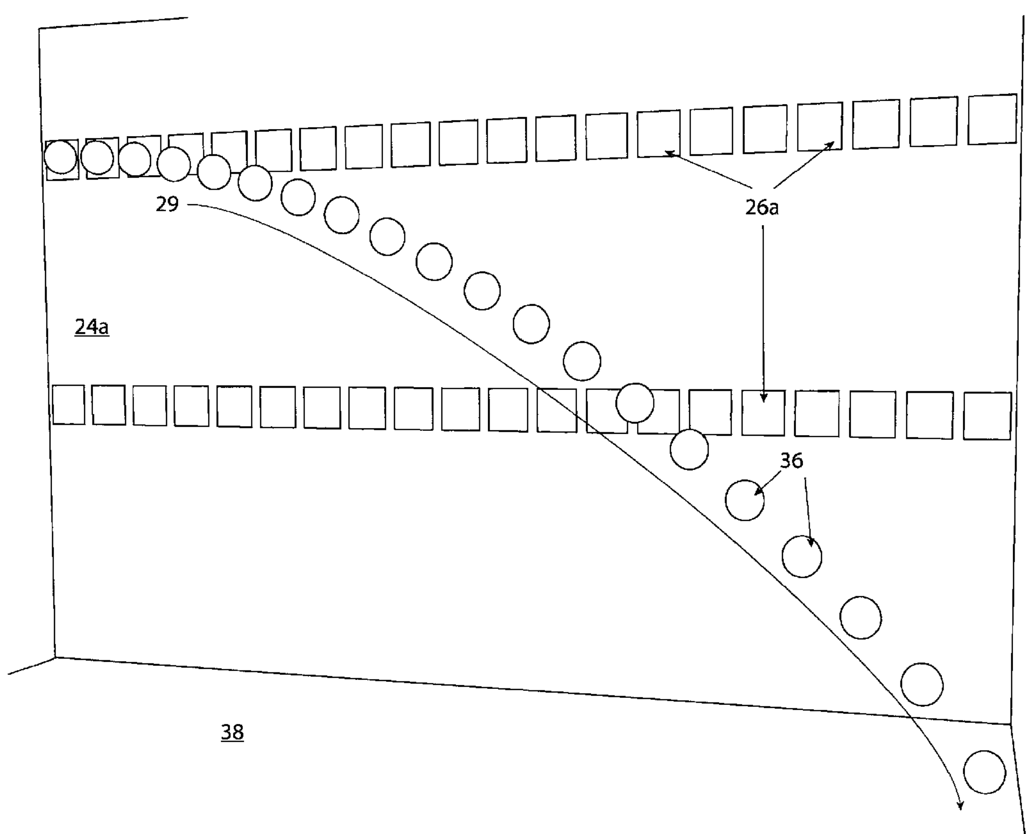
(57) **ABSTRACT**

An apparatus for dropping multiple objects into a visual field to create imagery including hollow ducts for conveying the objects to the visual field and computer-controlled gating devices for releasing the objects at desire times and sequences to produce the imagery.

19 Claims, 27 Drawing Sheets



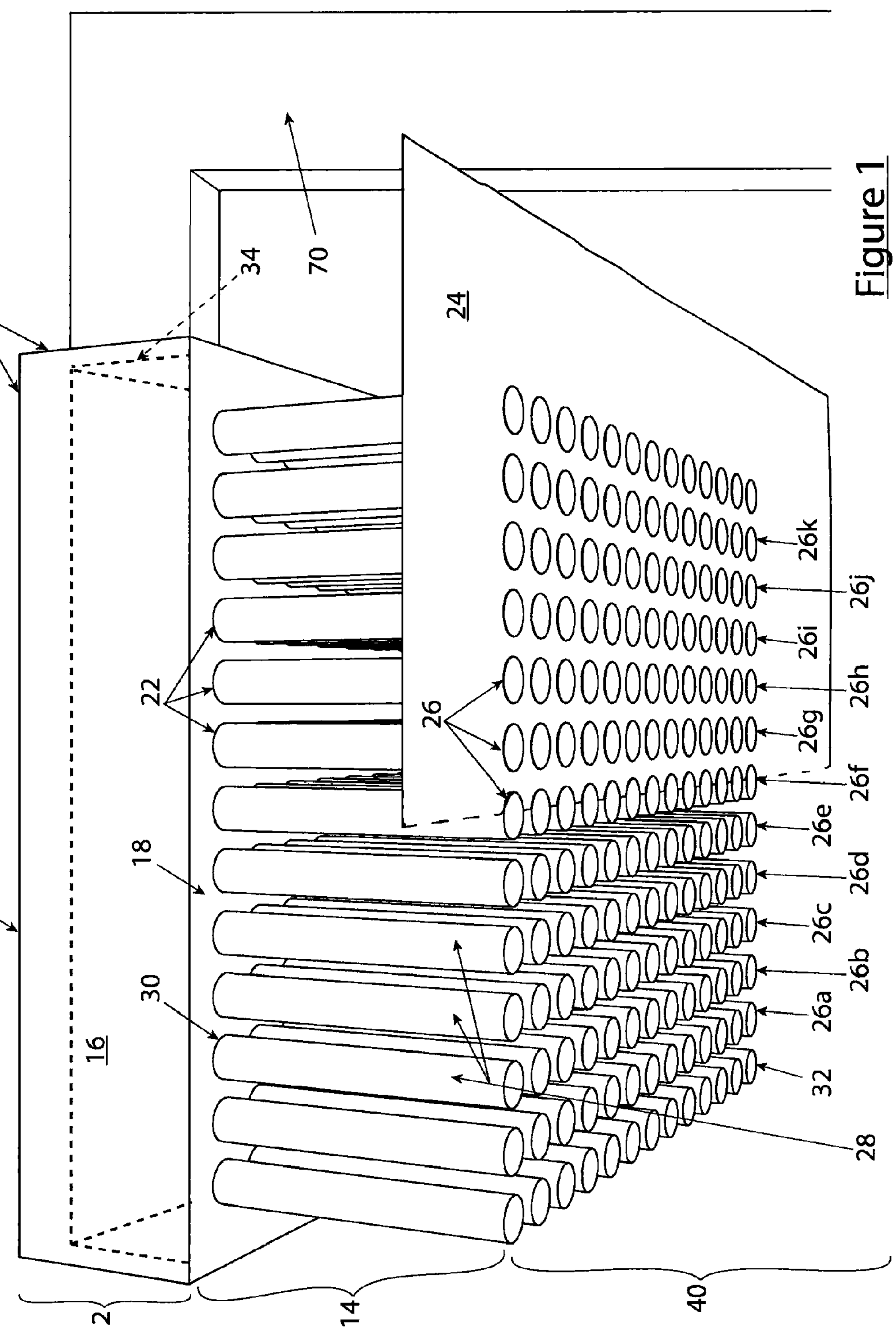

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Figure 1

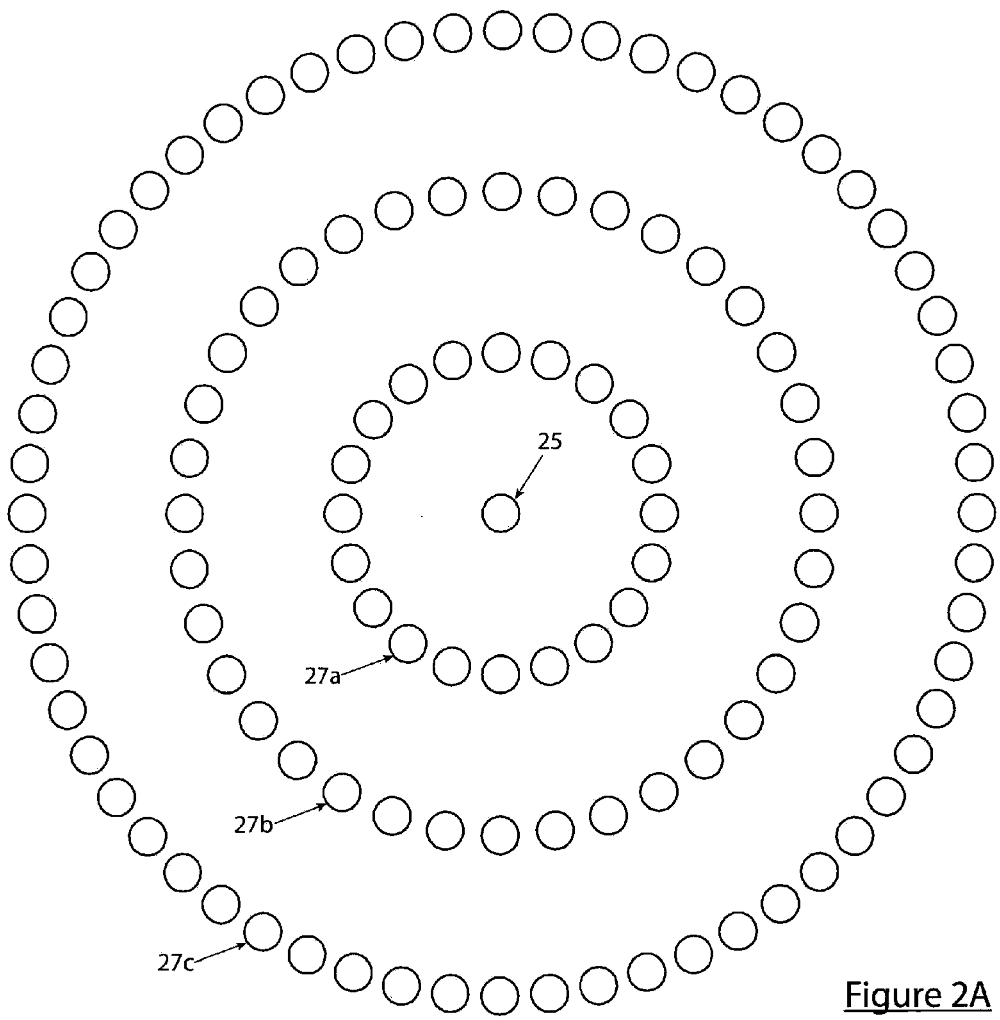


Figure 2A

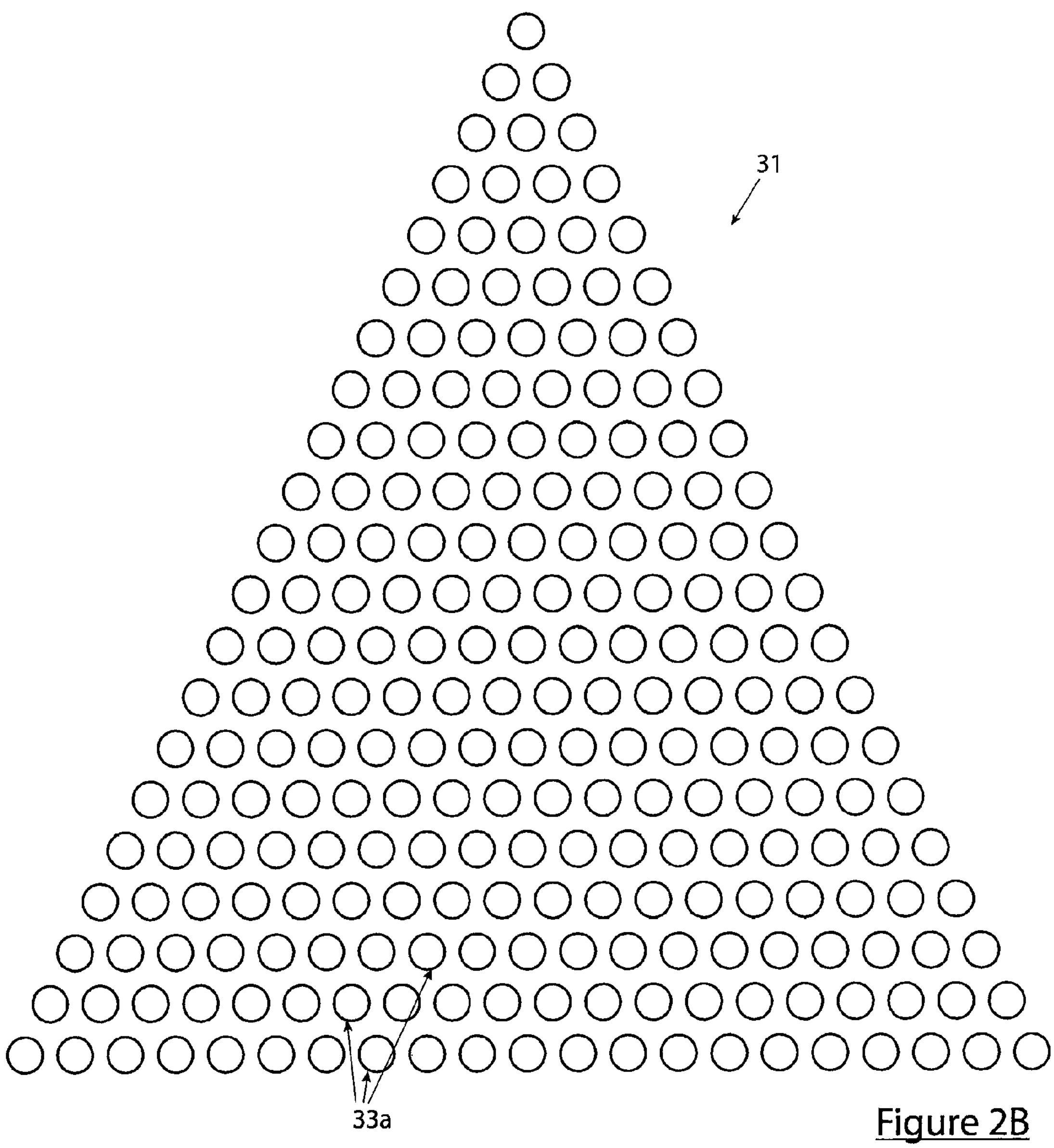


Figure 2B

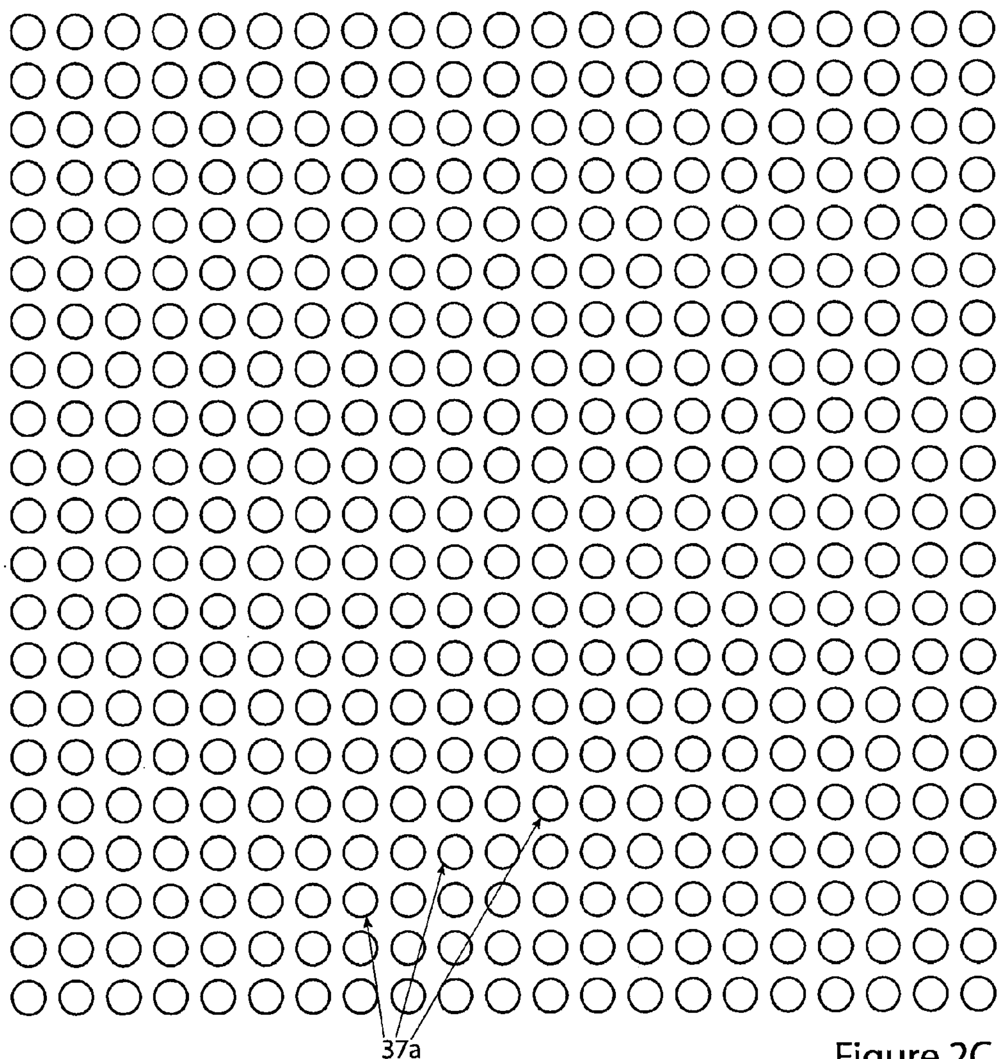


Figure 2C

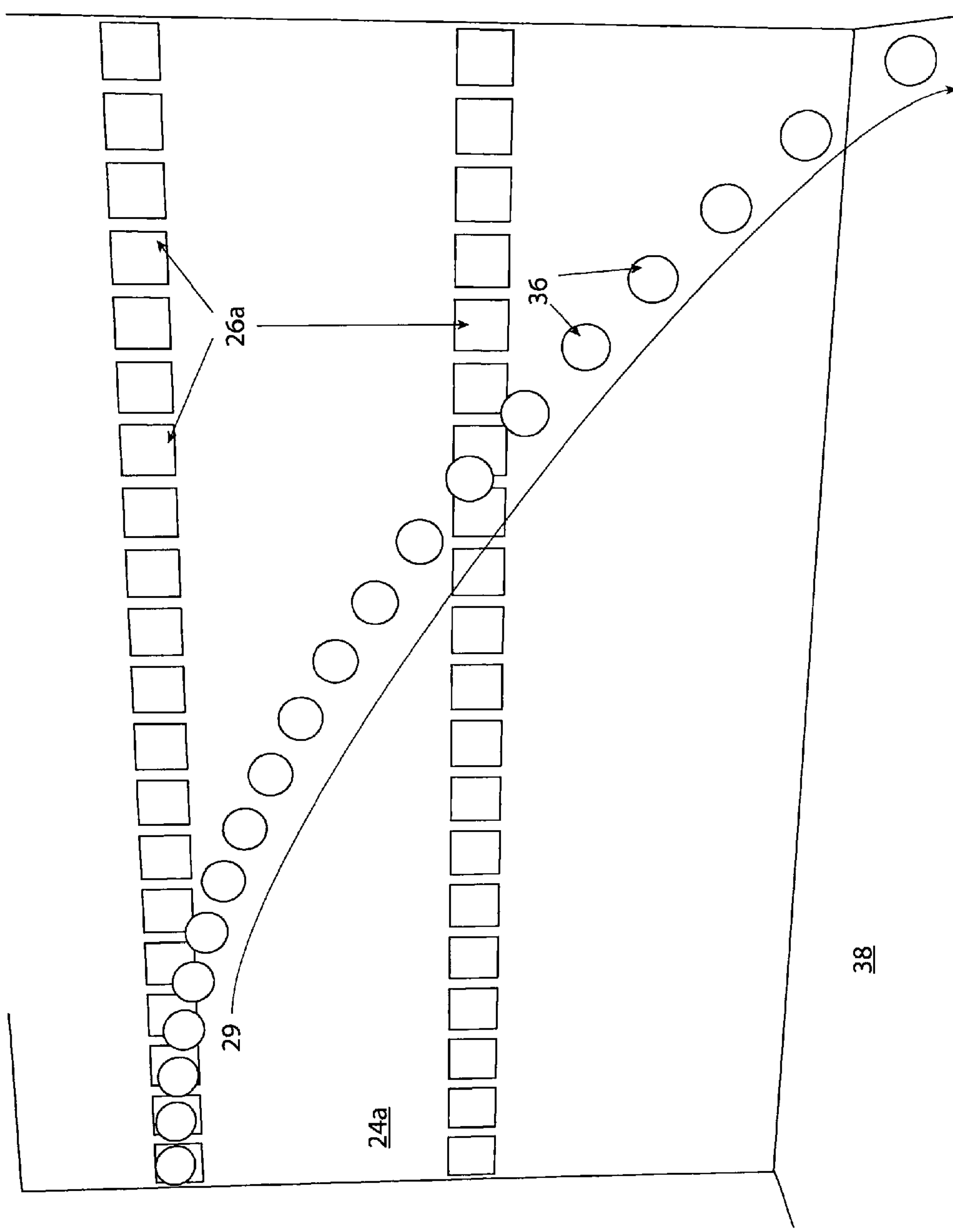


Figure 3

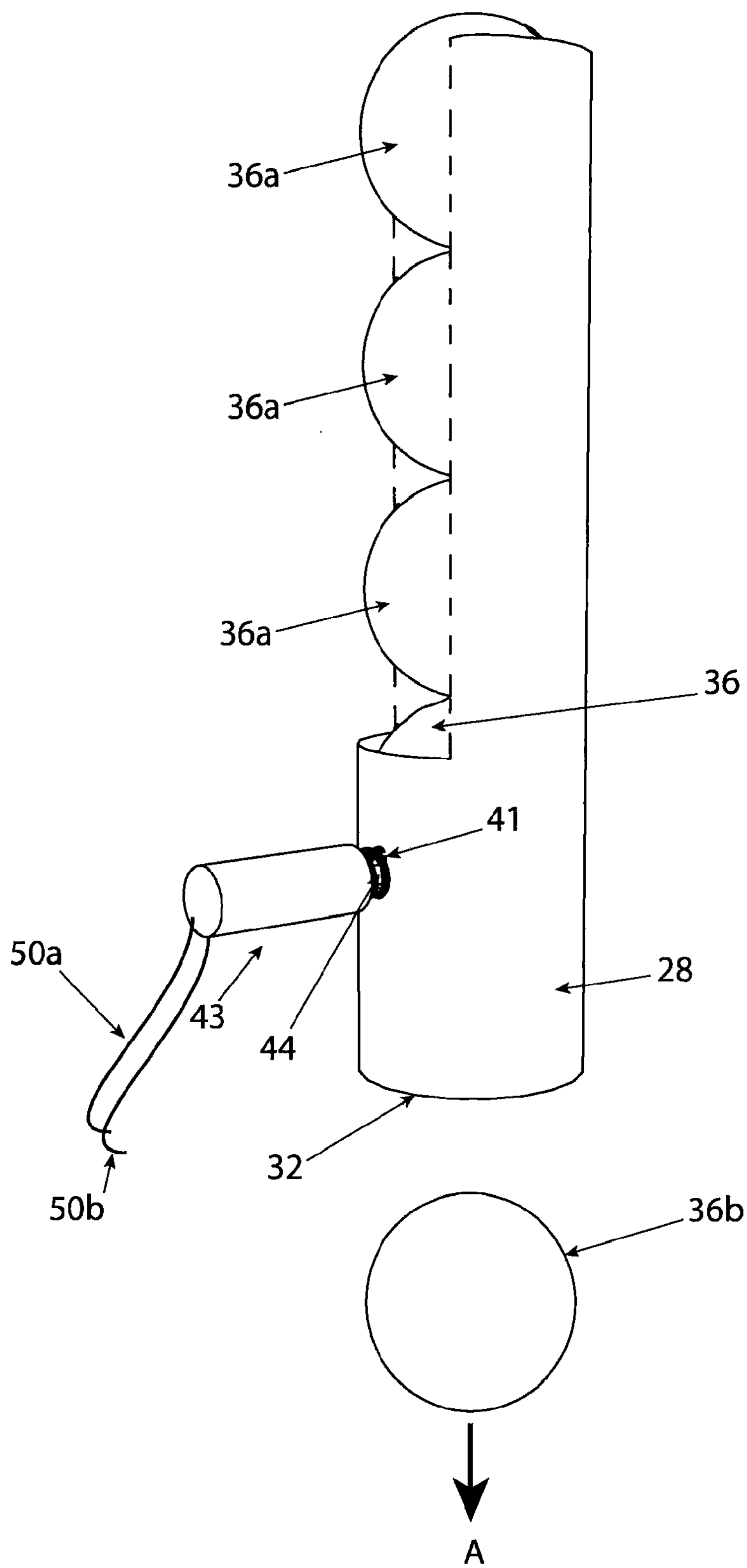


Figure 4A

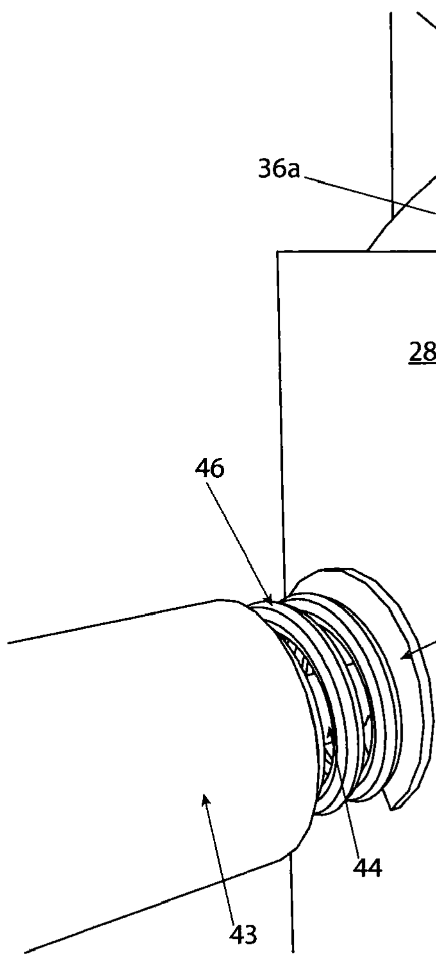


Figure 4B

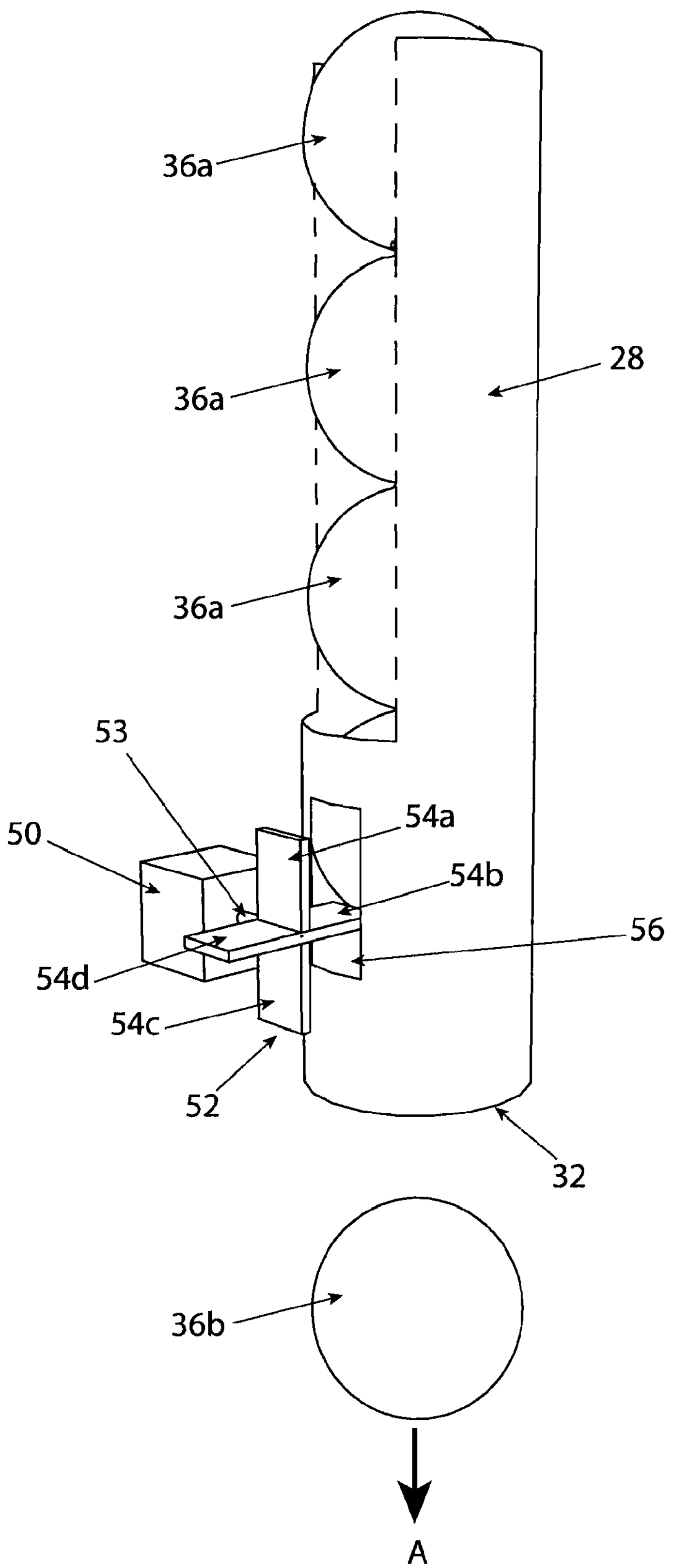


Figure 5

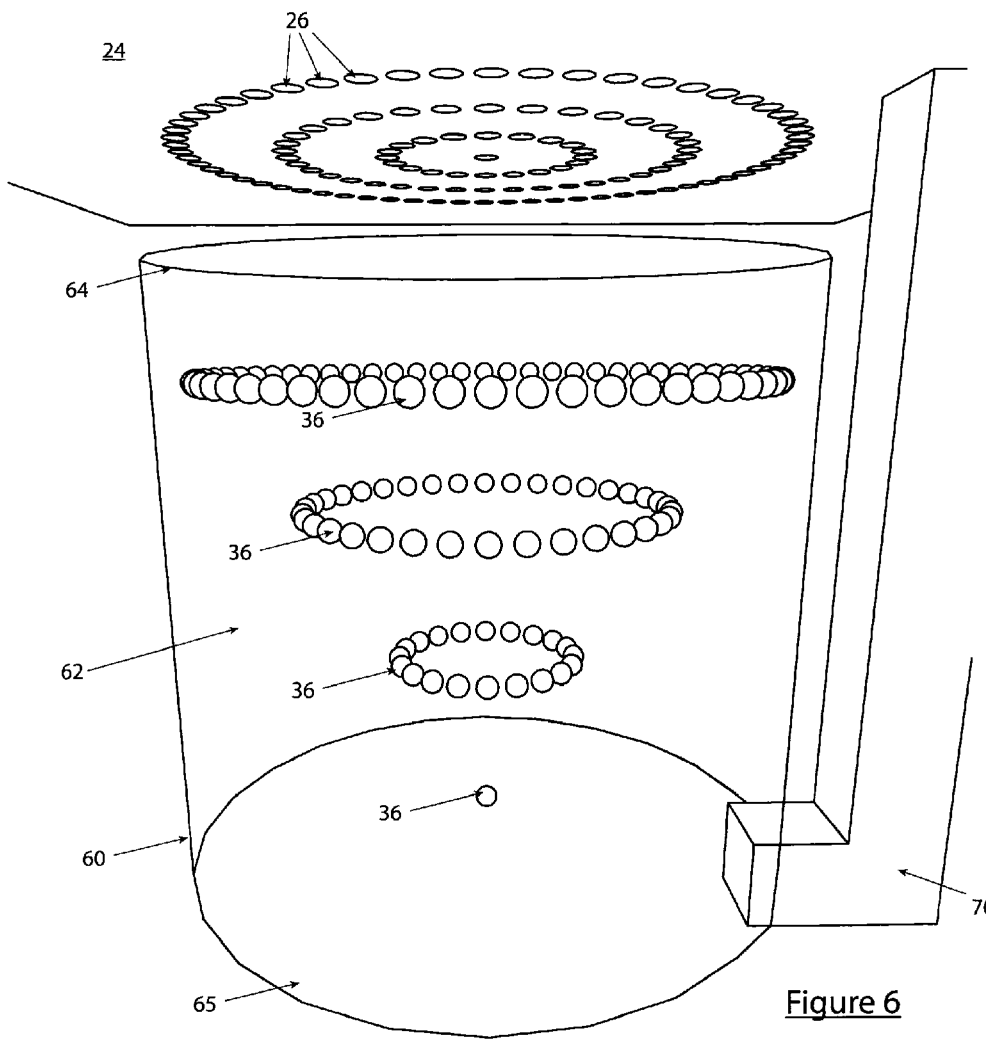


Figure 6

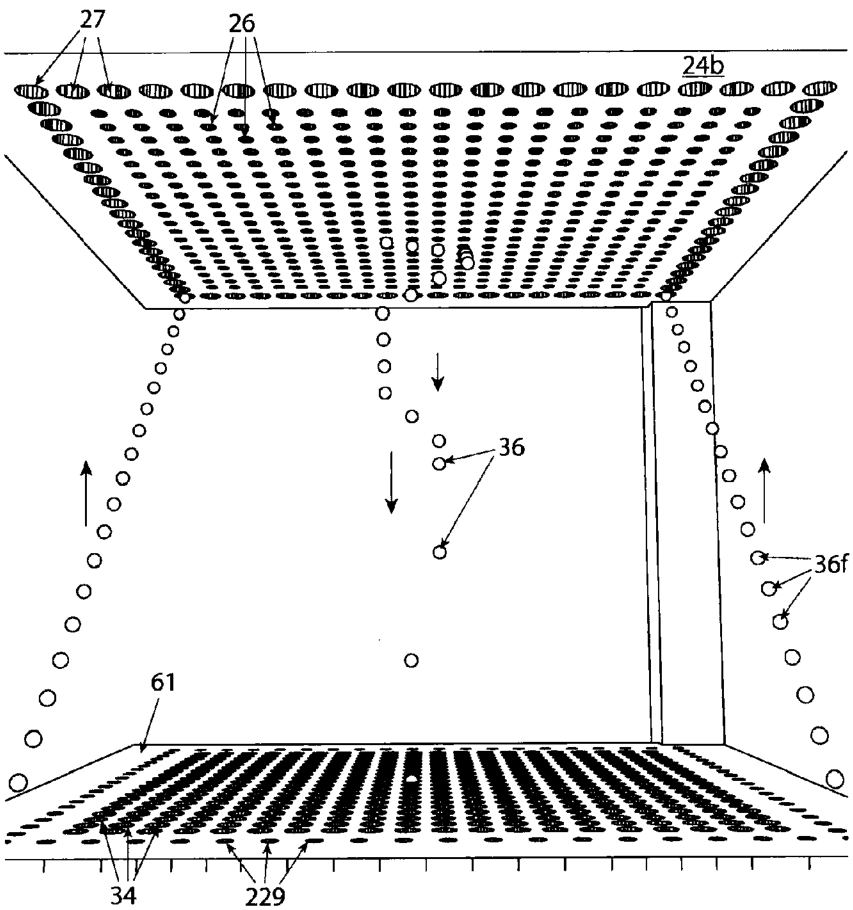
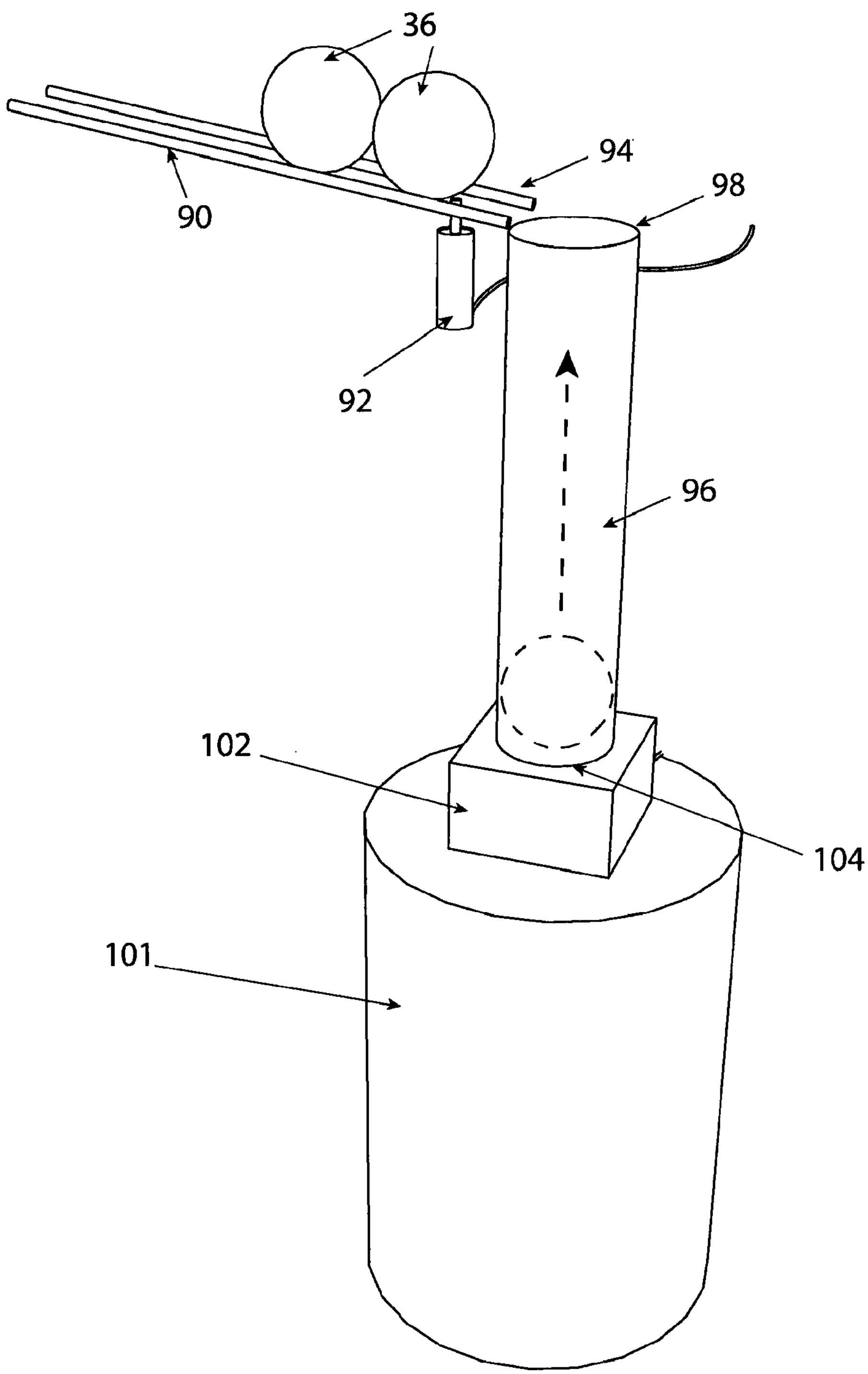


Figure 7



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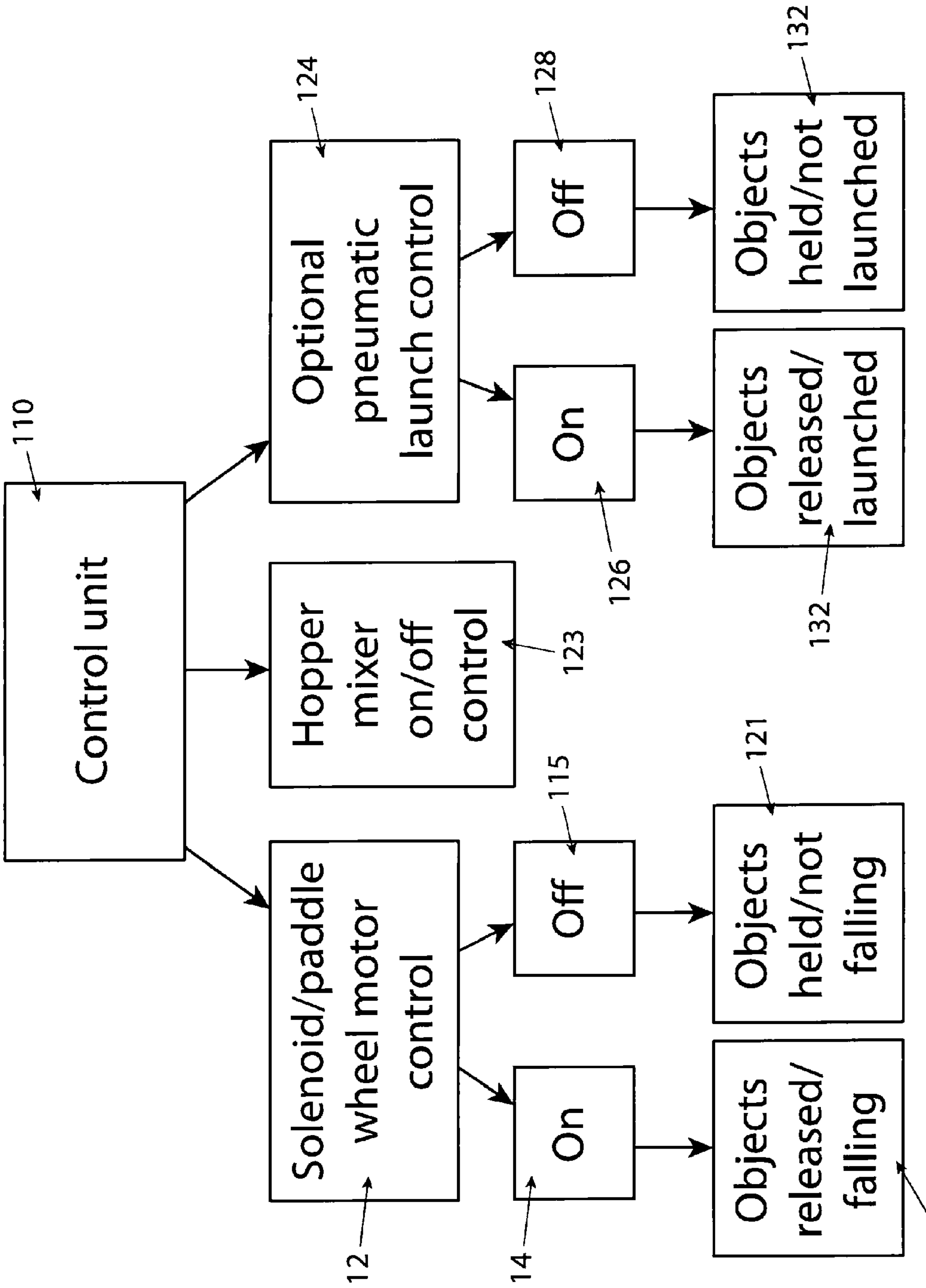
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Control unit
Solenoid/paddle wheel motor control
112
Hopper mixer on/off control
123
Optional pneumatic launch control
124
On
114
Off
115
On
126
Off
128
Objects released/ falling
119
Objects held/not falling
121
Objects released/ launched
132
Objects held/not launched
132

Figure 9

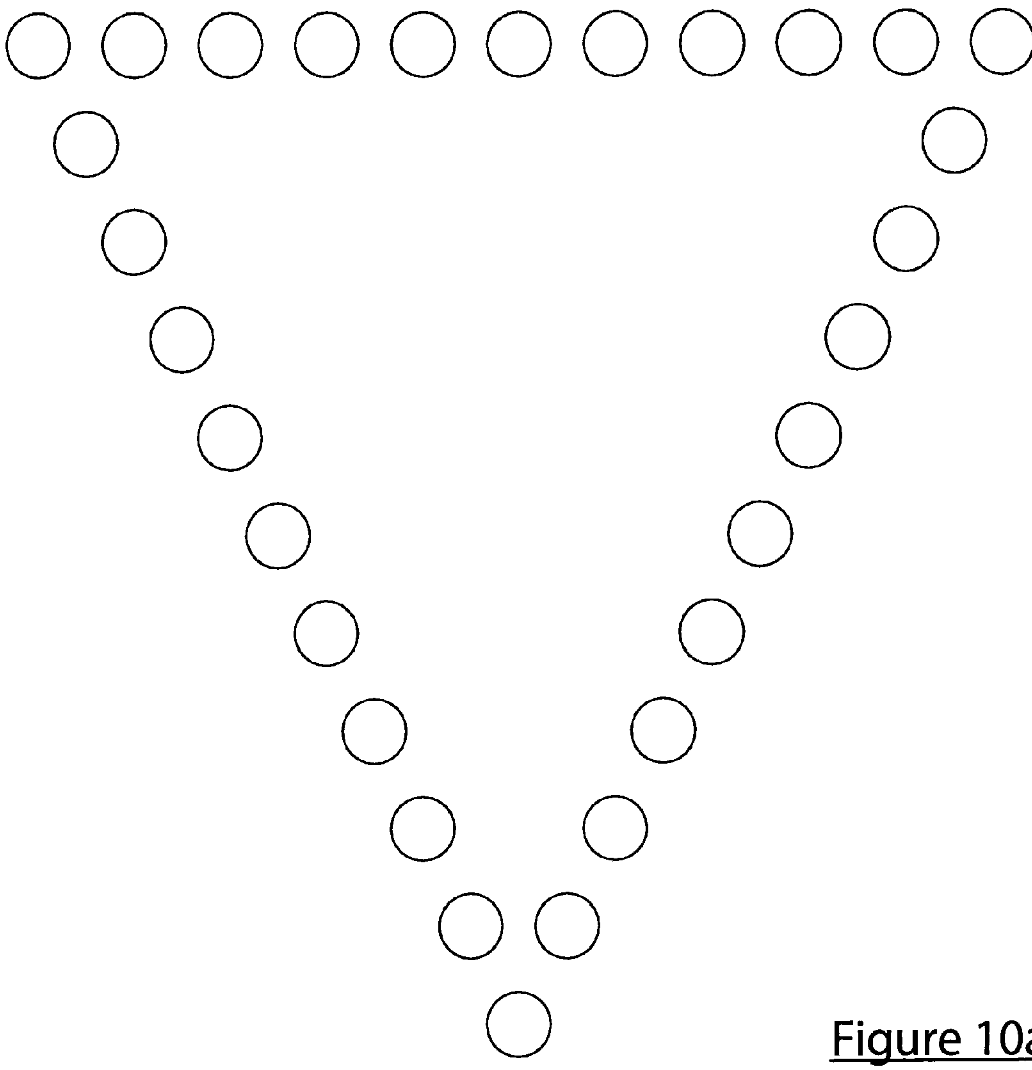


Figure 10a

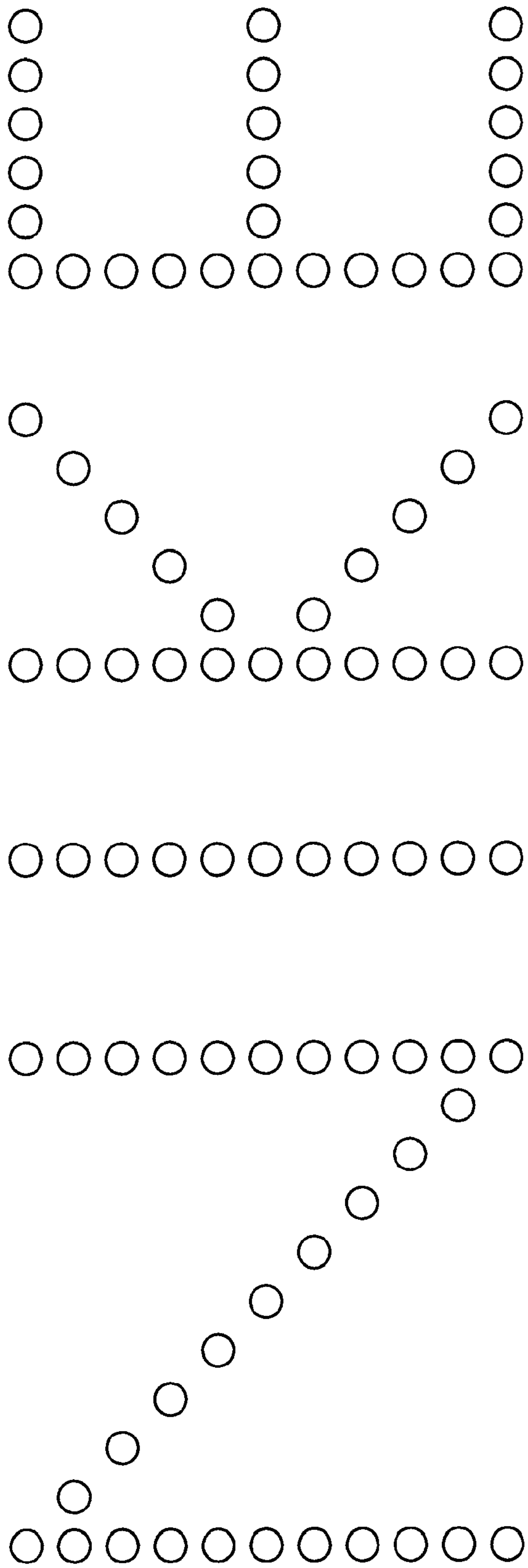


Figure 10b

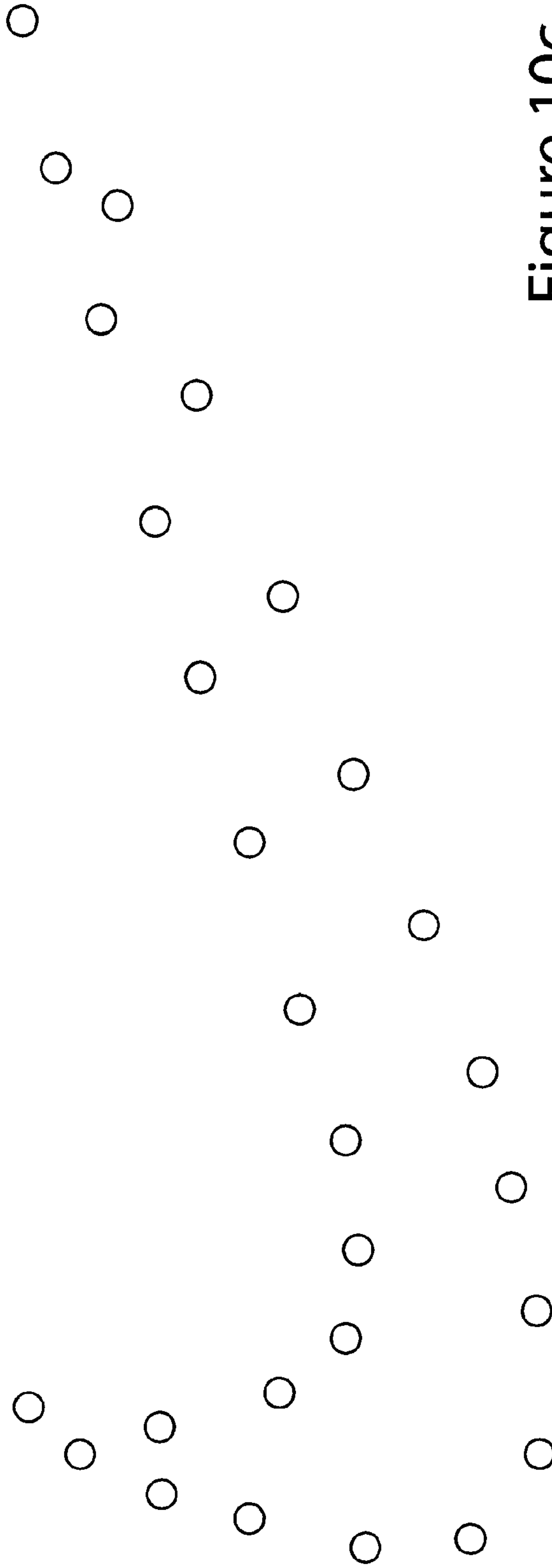


Figure 10c

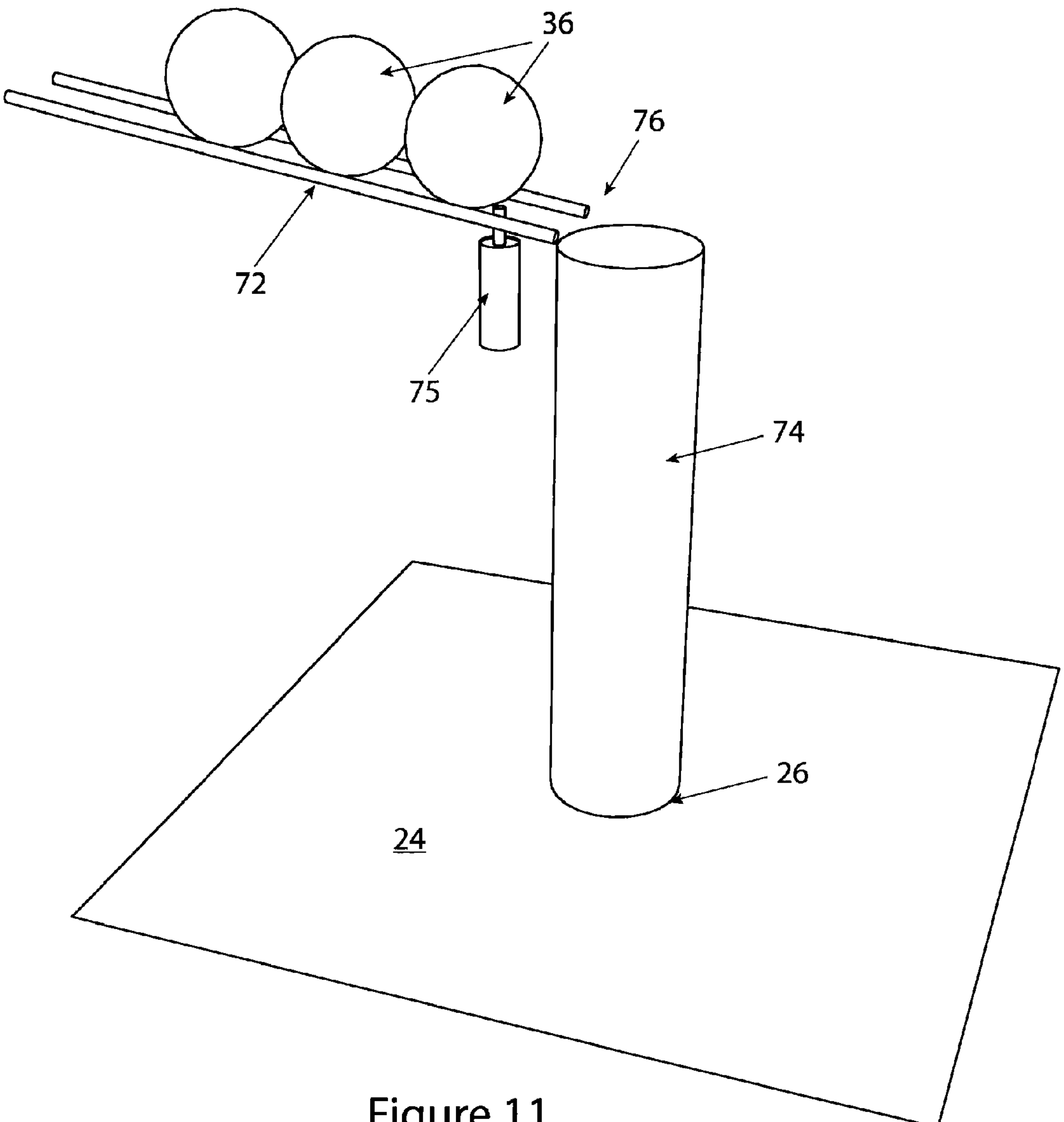


Figure 11

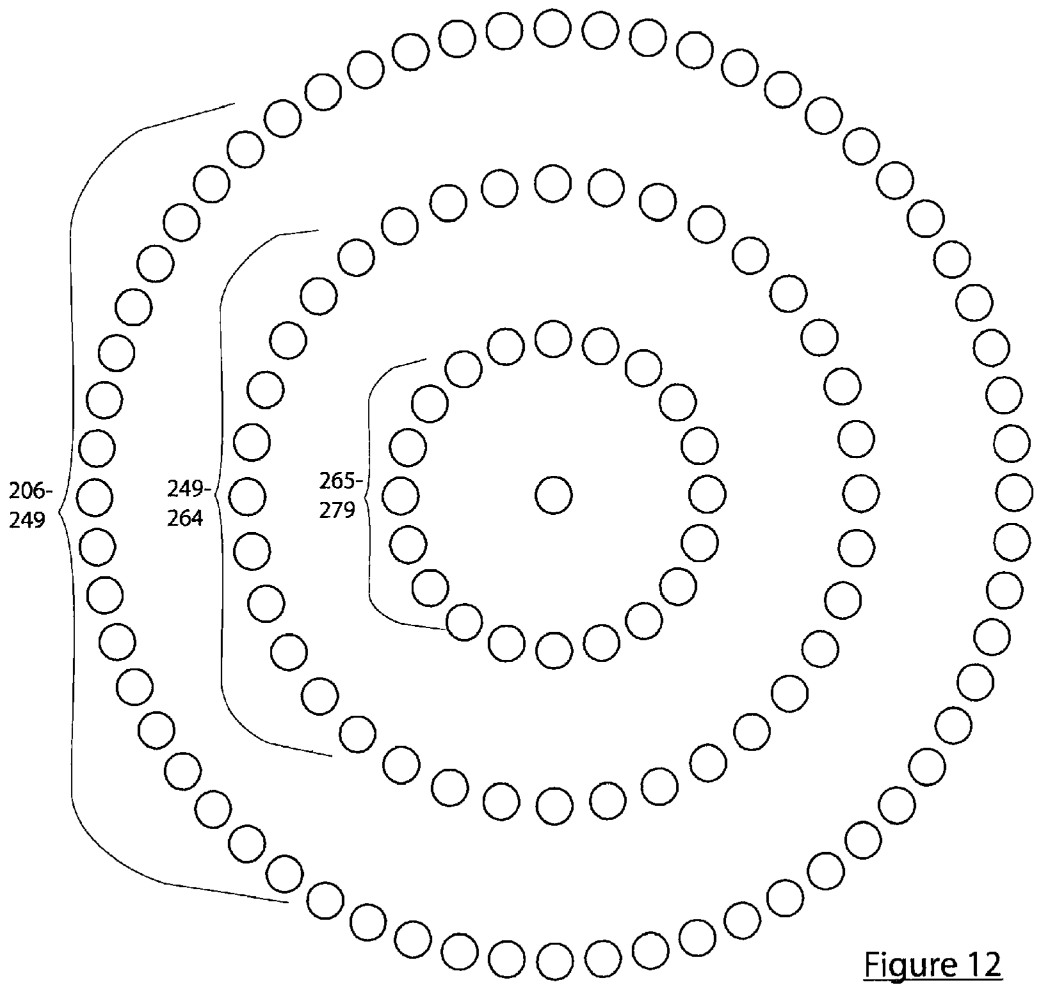


Figure 12

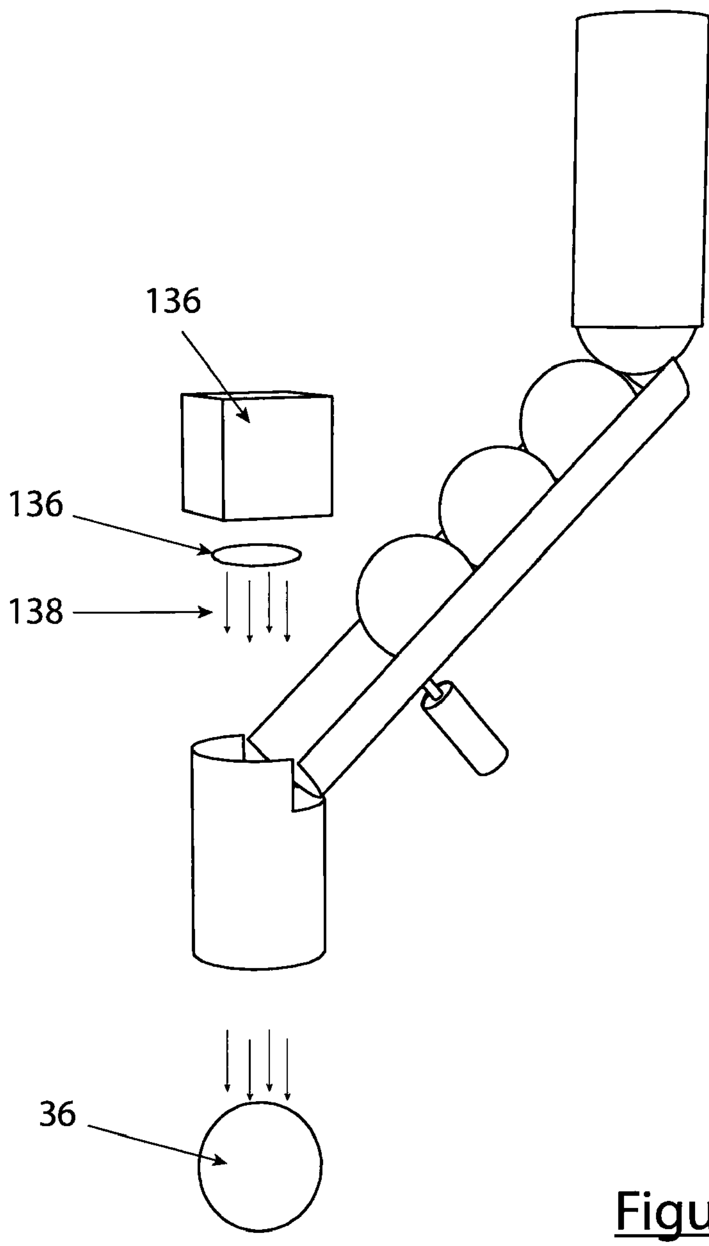


Figure 13

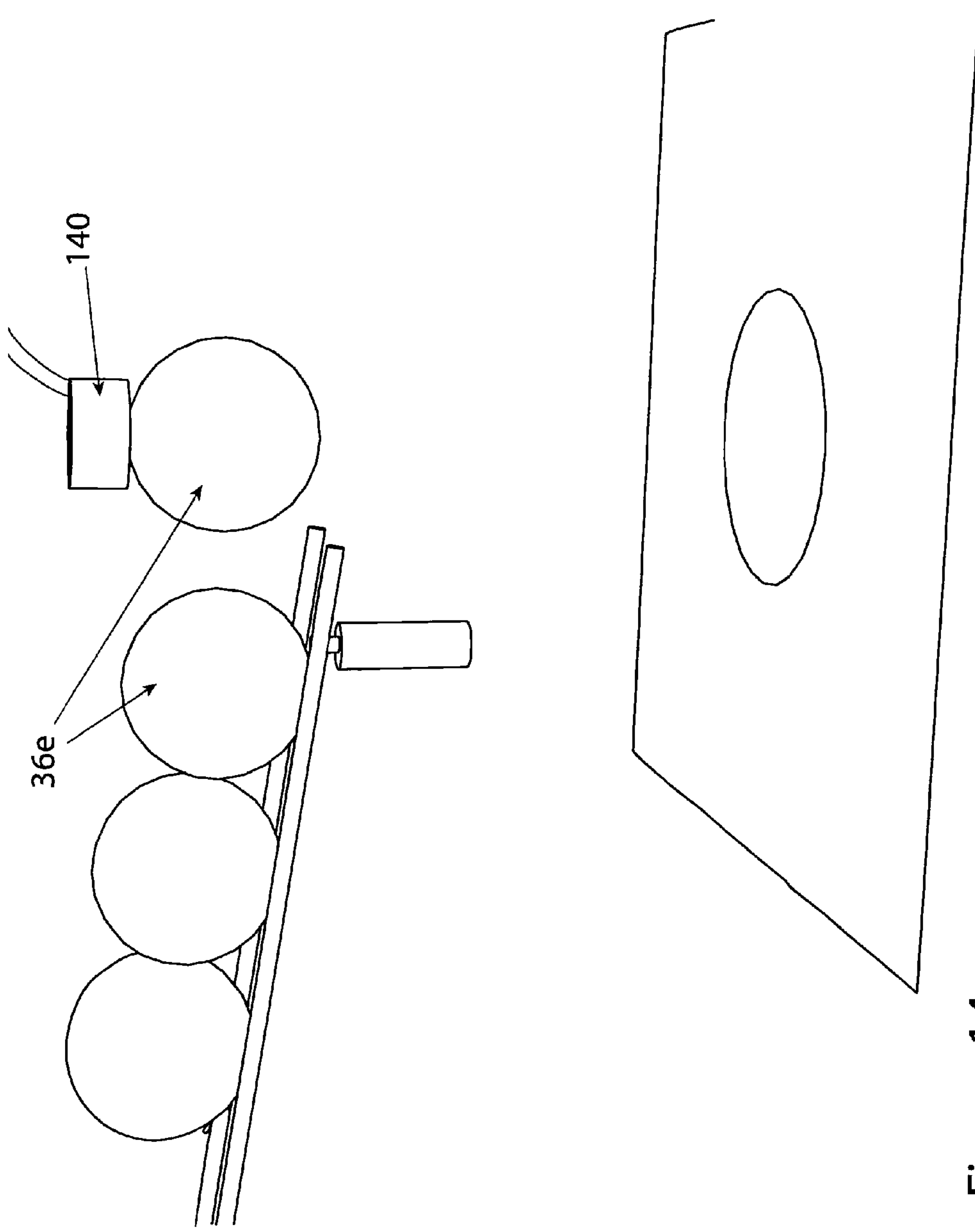


Figure 14

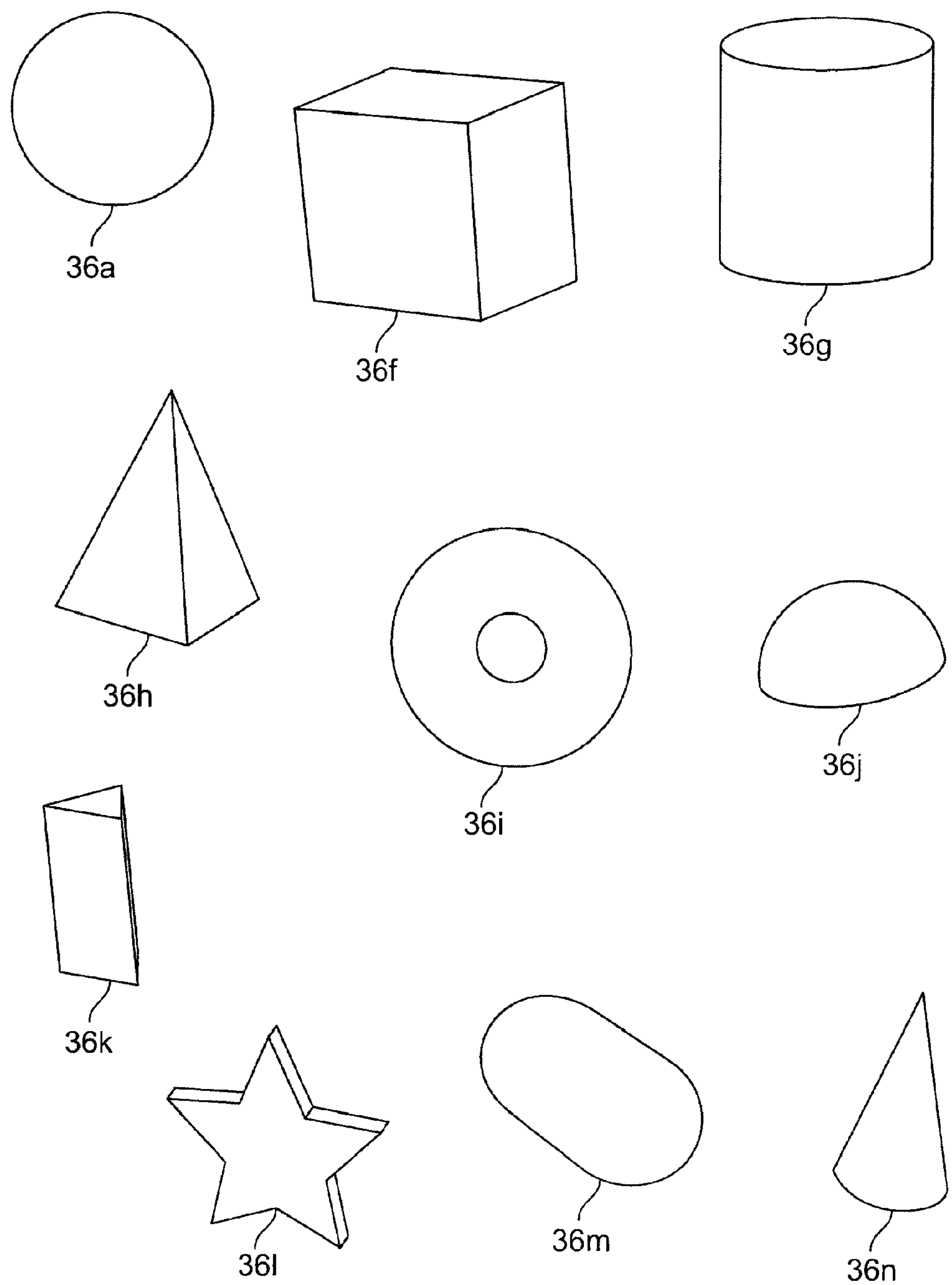


FIG. 15

Figure 16a

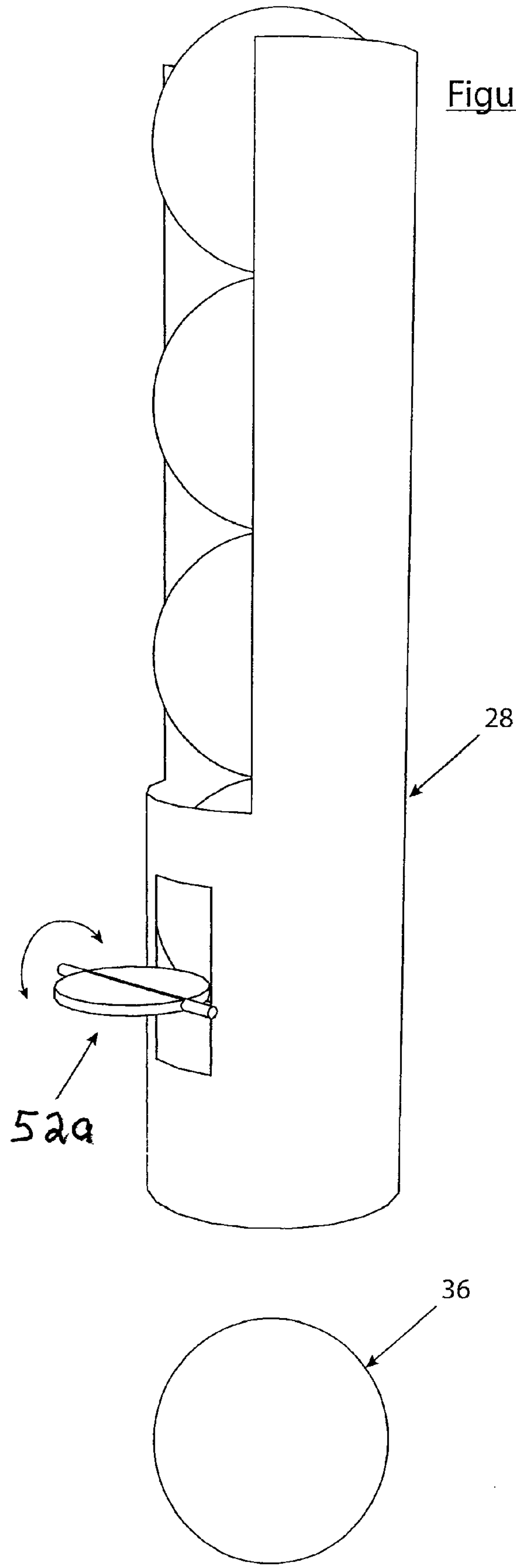
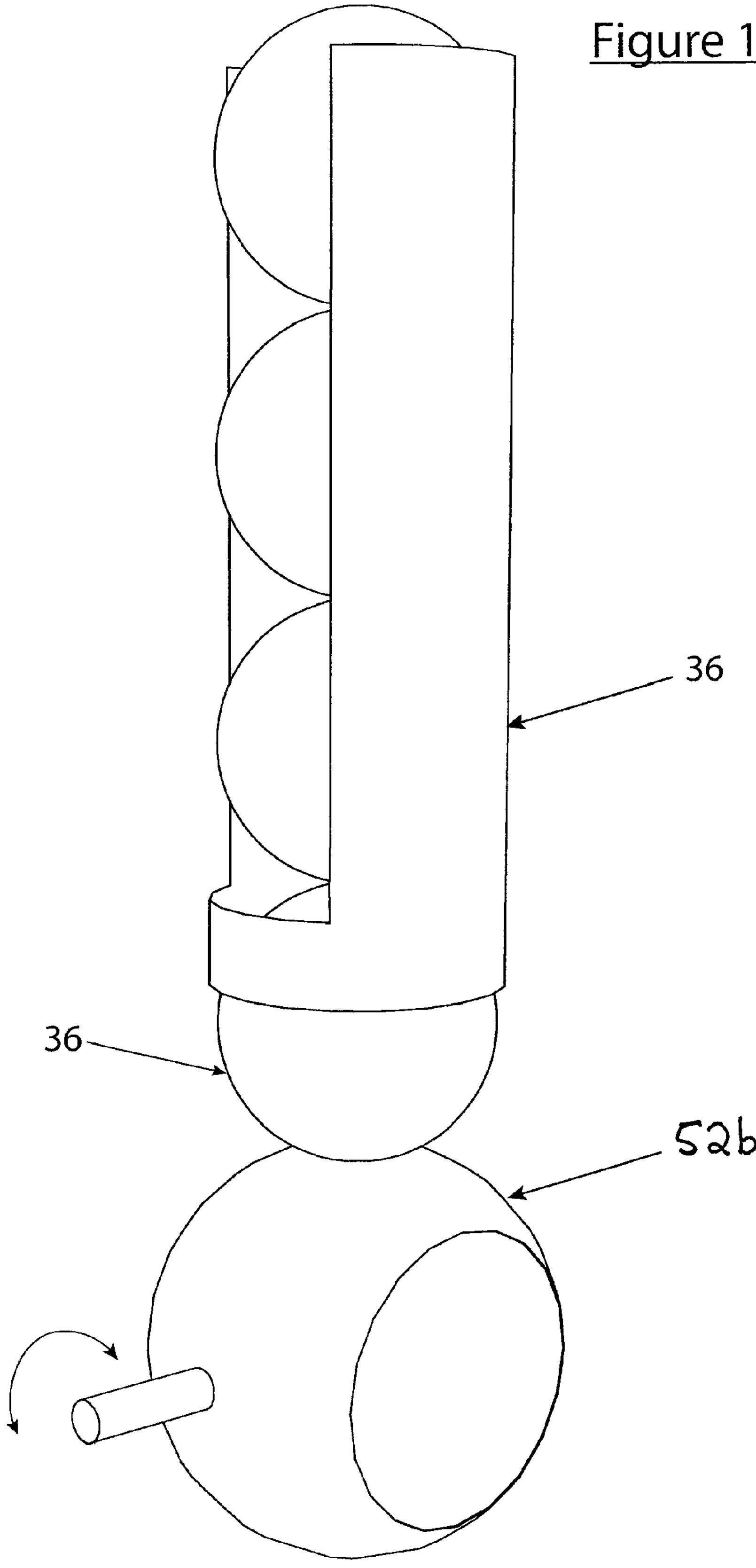


Figure 16b



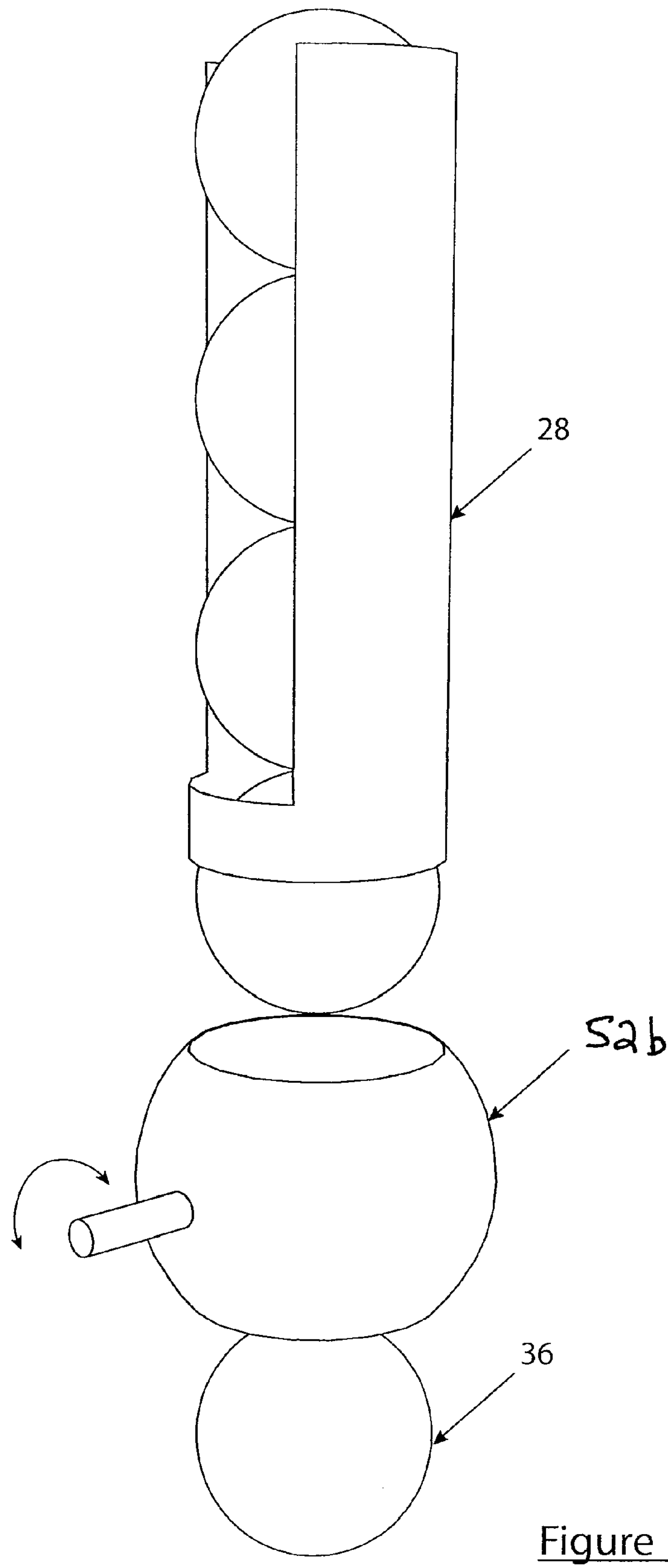


Figure 16c

Figure 17a

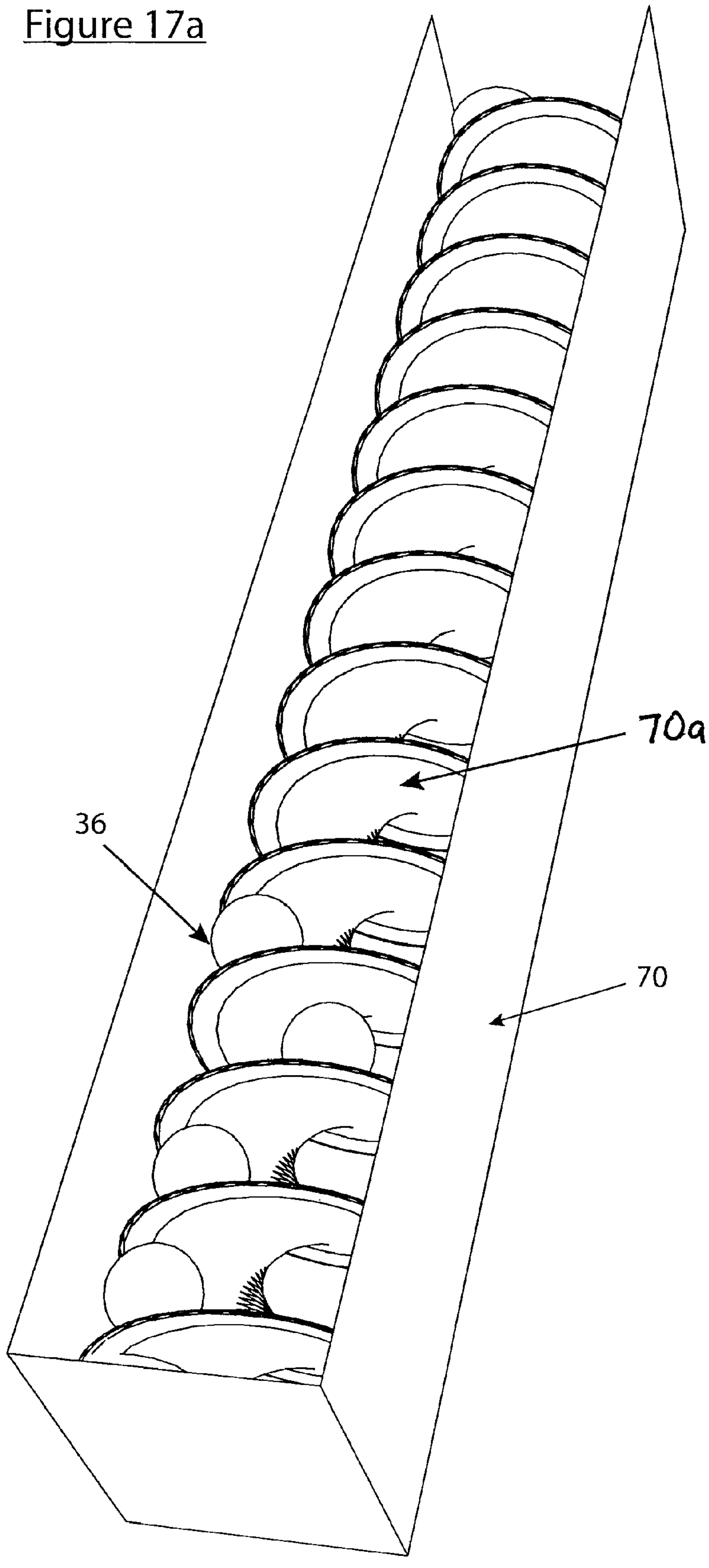


Figure 17b

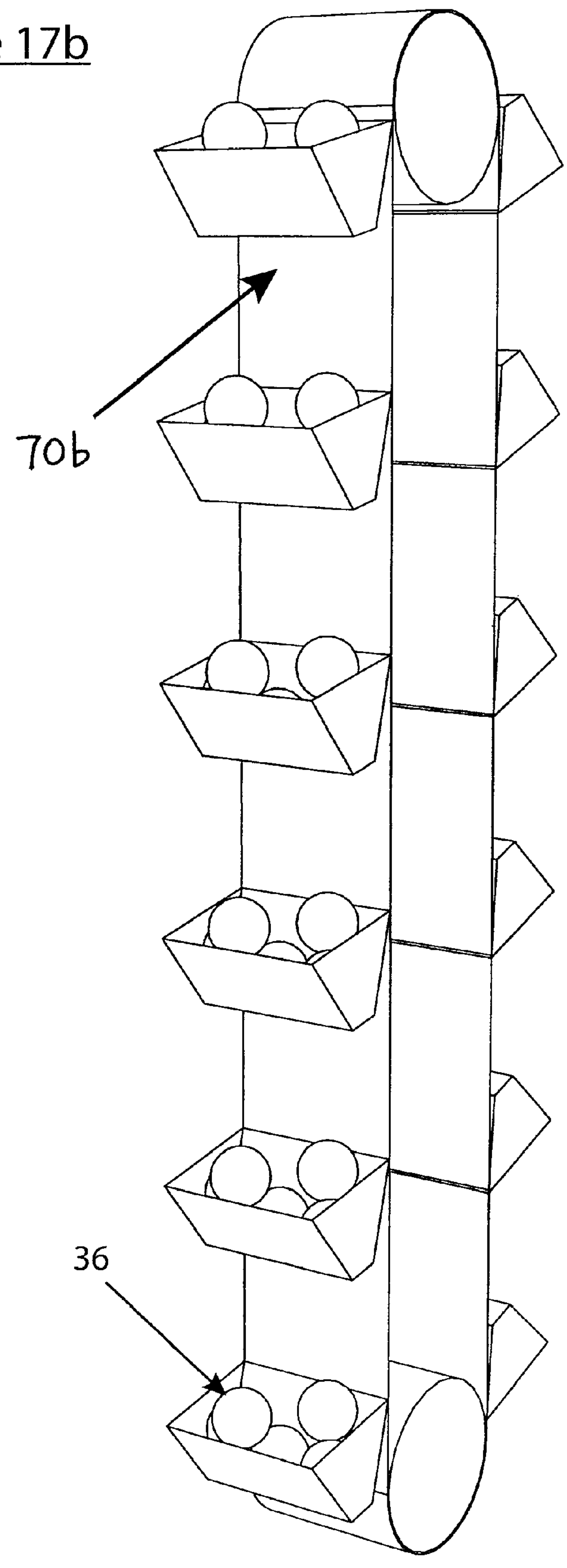


Figure 17c

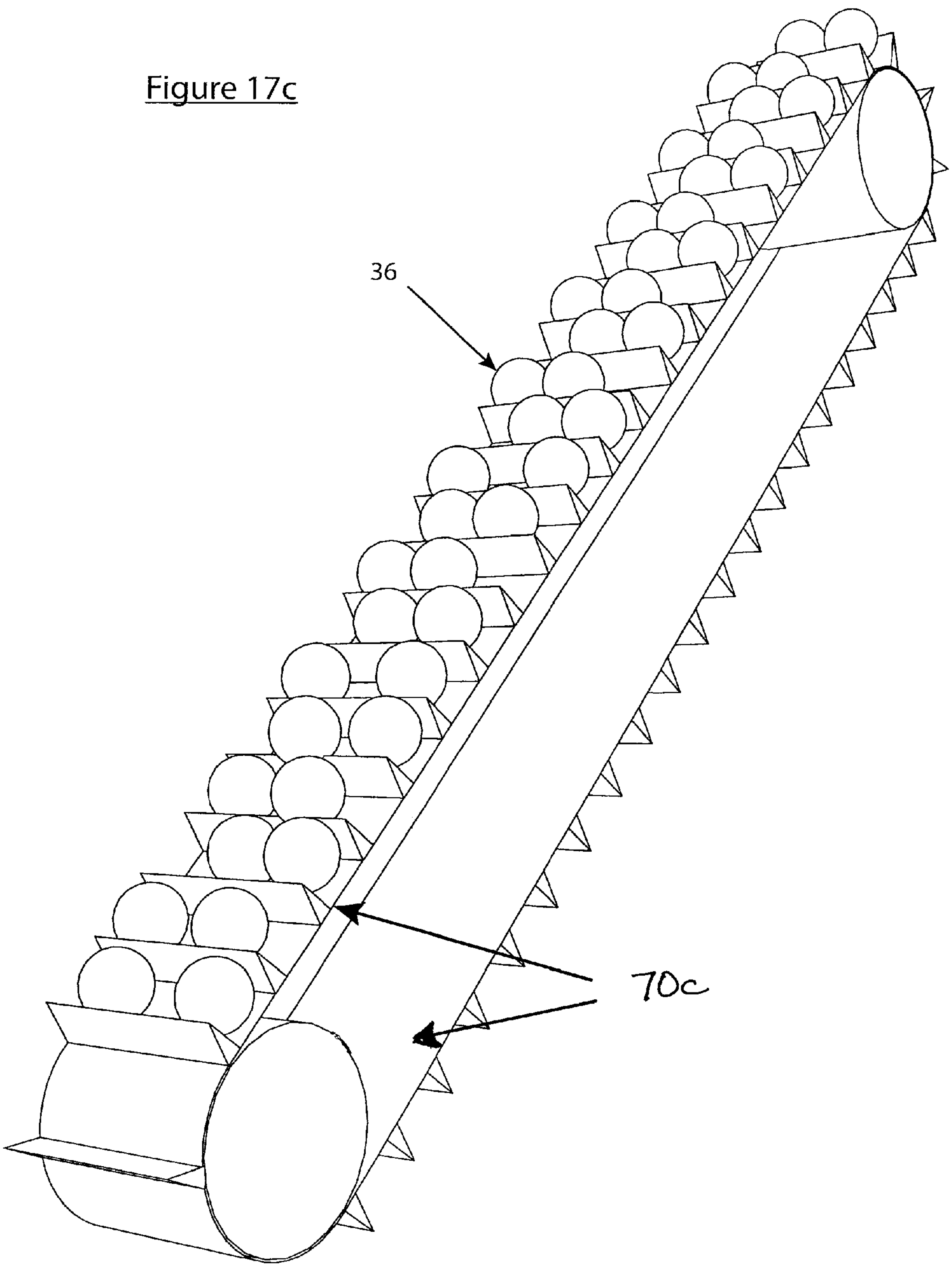
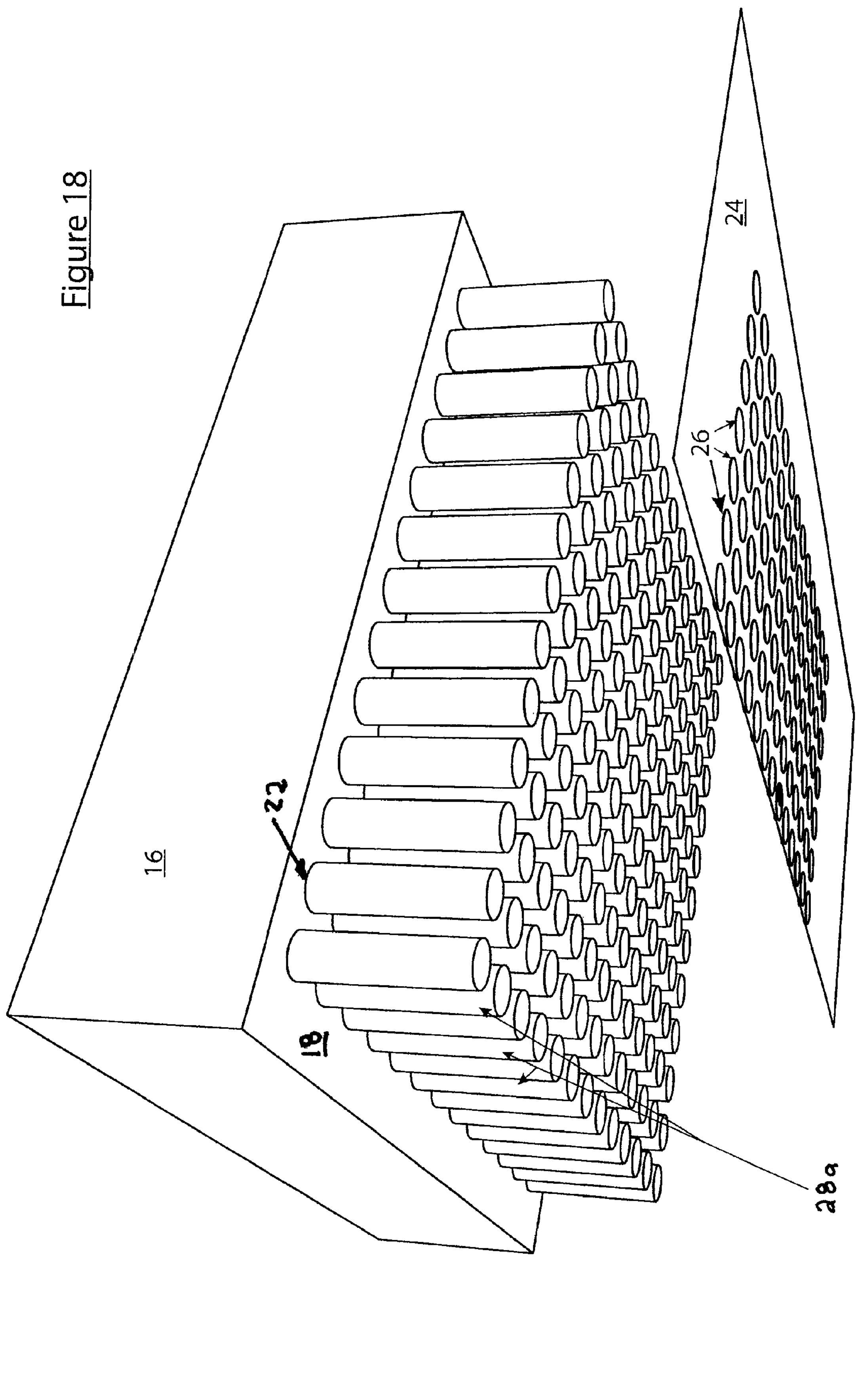


Figure 18



FALLING PATTERN IMAGERY SYSTEM

CROSS-REFERENCE TO RELATED PATENT APPLICATIONS

This patent application claims the benefit of U.S. Provisional Patent Application No. 61/755,729, filed Jan. 23, 2013.

FIELD OF THE INVENTION

This invention relates generally to moving multiple objects in a space and, more particularly, to methods and apparatus for synchronously dropping multiple objects in space in unique new ways to create novel imagery including stationary and dynamic abstract and manifest images.

BACKGROUND OF THE INVENTION

From almost the inception of kinetic art, people have been interested in moving objects in space in order to create visual effects relying on human, solar, wind, or magnetic powered motion. For most of the twentieth century such kinetically produced art has been limited primarily to single speed objects moving on rudimentary trajectories. And, while more complex kinetically produced art became possible when transmissions could be used to vary speed, most contemporary kinetically produced art has been limited to moving objects at a discreet small number of speeds on relatively simple trajectories.

SUMMARY

This invention comprises a system for creating unique imagery by synchronously dropping multiple recirculating objects in space to produce abstract and manifest images. "Abstract images" in this context are images whose content depends solely on intrinsic form. "Manifest images" in this context are apparent images that the viewer can see, recognize and understand, such as letters, words, geometrical images, and images of recognizable things.

The objects used in this system to kinetically produce imagery including abstract and manifest images are referred to as "visual field objects" because they are used to produce imagery within a viewer's visual field. Embodiments preferably use visual field objects that are spherical because their uniform symmetry simplifies the release and recirculation of the visual field objects within the system, without regard to how the spherical visual field objects are oriented as they move through the system. However, although more complex the field object shapes require more complex return mechanisms, any regular or irregular shape can be used as a field object. For example, cubes **36*f*** (FIG. **15**), cylinders **36*g*** (FIG. **15**), pyramids **36*h*** (FIG. **15**), toruses **36*i*** (FIG. **15**), hemispheres **36*j*** (FIG. **15**), prisms **36*k*** (FIG. **15**), star-shapes **361** (FIG. **15**), pill shapes **36*m*** (FIG. **15**) and cone shapes **36*n*** (FIG. **15**) may be used.

The visual field objects may be solid or hollow, and made of metal, plastic, wood, rubber, glass, foam, or other appropriate material. For example, visual field objects in the form of high density polyethylene spheres of a diameter of less than about 1 inch to greater than about 12 inches may be used with a range of about 4 to 8 inches currently being preferred. Preferably, the weight of the spheres will be chosen or adjusted as appropriate for a particular application. For example, where air currents are present, the spheres should be heavy enough to fall generally vertically, without being diverted by the air currents. On the other hand, since heavier spheres (and other shaped visual field objects) will be more difficult to recirculate, their weight should be adjusted to avoid placing undue stress on the recirculating system. When lightweight materials like foam are used, an appropriate weight may be located within the visual field objects. When resilient material like rubber is used and a hard surface is located at the bottom of the visual field, the visual objects will bounce when they hit this hard surface, adding interest to the resulting imagery. The timing and height of the bounces produced can be controlled by controlling the velocity and positioning of the dropping visual field objects.

Finally, both the abstract and the manifest images may be in either linear three-dimensional form or full three-dimensional form. Images in "linear three-dimensional form" are images generated generally in a plane or without depth, but comprised of three-dimensional visual field objects which themselves are three-dimensional. Images in "full three-dimensional form" are images generated by field image objects disposed in three dimensions or having an extension in depth.

BRIEF DESCRIPTION OF THE DRAWINGS

In order to aid in understanding the invention, it will now be described in connection with exemplary embodiments thereof with reference to the accompanying drawings in which like numerical designations will be given to like features with reference to the accompanying drawings wherein:

FIG. **1** is a partial perspective view of an embodiment of the apparatus of the invention;

FIG. **2**A illustrates a ceiling aperture configuration including a central aperture and concentric circles of apertures;

FIG. **2**B illustrates a ceiling aperture configuration in which the apertures are ranged triangularly;

FIG. **2**C illustrates an embodiment comprising a ceiling aperture configuration in which the apertures are ranged in a rectangle;

FIG. **3** illustrates a near vertical façade or wall with apertures at the end of hollow ducts from which visual field objects may be released and fall generally vertically to produce a fully three-dimensional manifest image of a cube;

FIGS. **4**A and **4**B are views respectively of a duct for transporting objects which is partially cut-away to show the objects within the duct and a gating device in the form a solenoid mounted to the duct;

FIG. **5** is a view of another gating device mounted to a duct;

FIG. **6** is a view showing a receptacle which will be located below the visual field of the apparatus containing a fluid such as water or an appropriate oil to reduce bounce-back by the visual field objects and also reduce noise as they are received in the receptacle;

FIG. **7** illustrates a façade or ceiling with a rectangular array of release apertures generally centered in the ceiling, a rectangular array of larger return apertures encircling the rectangular array of release apertures and both falling and returning visual field objects;

FIG. **8** illustrates an apparatus for launching visual field objects from below a visual field back to a receptacle above the visual field;

FIG. **9** is a flow diagram illustrating an embodiment of a control unit and apparatus in accordance with embodiments of the invention;

FIG. **10**A is a representation of visual field objects producing a triangular shape in accordance with an embodiment and FIGS. **10**B and **10**C respectively illustrate the sequential display of a company logo followed by the letters of its trademark;

FIG. **11** illustrates an embodiment in which visual field objects **36** are supported by open, gently inclined laterally confining ramps aligned with tubes that open at ceiling apertures **26**;

FIG. **12** illustrates a ceiling aperture configuration where falling visual field objects may be timed to produce superpositioned waves in a fluid;

FIG. **13** is a view of an arrangement for illuminating clear or translucent visual field objects which are released from a ramp and pass below a collimated light beam as they fall through a ceiling aperture;

FIG. **14** illustrates an object drop structure in which ferromagnetic visual field objects are retained and released using an electromagnet;

FIG. **15** illustrates a series of visual field objects that may be used in embodiments;

FIG. **16***a* illustrates a butterfly valve gating system that may be used in embodiments;

FIGS. **16***b* and **16***c* illustrate a partial ball valve gating device in open and closed positions that may be used in embodiments;

FIG. **17***a* illustrates a screw conveyor recirculating unit that can be used in embodiments;

FIG. **17***b* illustrates a bucket conveyor recirculating unit that can be used in embodiments;

FIG. **17***c* illustrates a belt conveyor recirculating unit that can be used in embodiments; and

FIG. **18** shows an embodiment in which ducts do not extend the entire distance between the container apertures and the façade apertures.

DETAILED DESCRIPTION OF THE INVENTION

The embodiments of the invention described below are not intended to be exhaustive or to limit the invention to the precise structures and operations disclosed. Rather, the described embodiments have been chosen to explain the principles of the invention and its application, operation and use in order to best enable others skilled in the art to follow its teachings.

Referring to FIG. **1**, a falling pattern imagery system embodiment **10** is illustrated including an upper section **12**, a lower section **14**, and a visual field **40**. Upper section **12** includes a rectangular hopper **16** having a bottom panel **18** and sidewalls **20** about the perimeter of the hopper. The top **21** of the hopper is open and a plurality of apertures **22** are distributed across the bottom panel of the hopper.

While only a single aperture **22** need be present in the bottom panel, preferably the bottom panel will include a plurality of apertures. The apertures may be arranged in a random configuration or in an orderly configuration which may be a geometric shape, a regular or irregular matrix, an outline of a visual object, etc. If, for example, the may be arranged in a geometric shape with a central aperture **25** and concentric circles of apertures **27**A-**27**C of FIG. **2**A. Visual field objects may be dropped from the apertures in patterns that advance along the circles to produce dropping helical shapes by sequentially dropping visual field objects from central aperture **25**, then sequentially through the apertures of Circle **27***a*, then sequentially through the apertures of concentric circle **27***b* and finally sequentially through the apertures of circle **27***c*.

FIG. **2**B illustrates an embodiment comprising a ceiling aperture configuration **31** in which apertures **33** are ranged triangularly. Thus, for example, if visual field objects were dropped simultaneously or sequentially from the apertures **33***a* along the periphery of the triangular image, a fully three-dimensional manifest image of a triangular prism extending from the top to the bottom of the visual field could be produced.

FIG. **2**C illustrates an embodiment comprising a ceiling aperture configuration **45** in which apertures **37***a* are ranged in a rectangle. Thus, for example, if visual field objects were dropped simultaneously or sequentially from the apertures **37***a* along and "X" extending from the corners of the rectangular ceiling aperture configuration, a fully three-dimensional manifest image of an "X" extending from the top to the bottom of the visual field could be produced.

Hopper **16** (FIG. **1**) may be any shape or size desired. Indeed, any shape or type of container for receiving or dispensing visual field objects that are either present in the hopper or recirculated to it may be used. Typically, the hopper or other container will be fixed by conventional means in an area above a façade that hides the hopper and other components of the falling pattern imagery system. A façade that functions in this way will be represented generally below by ceiling **24**. The falling pattern imagery system may also be constructed without a façade or ceiling or with only a partial façade or ceiling.

Ceiling **24** will include apertures **26** corresponding in number, position and size to apertures **22** in bottom panel **18**. If, however, less than all of the apertures in bottom panel **18** are employed, the ceiling may include apertures corresponding only to those bottom panel apertures that are employed. Also, while it is preferred that apertures **26** be of the same size as apertures **22**, apertures **26** may be larger than apertures **22**.

Hopper **16** and ceiling **24** are oriented with respect to each other so that their respective apertures **22** and **26** are in alignment. Preferably, the hopper will extend across the entire portion of the ceiling that contains apertures **26** so that all of the ceiling apertures may pass visual field objects received from the hopper, as will become clear from the discussion below. Although it is preferred that the ceiling below the hopper be generally horizontally disposed as shown, it may be placed at any desired angle greater than 90° from the vertical (e.g., not horizontal and not vertical) up to just short of 90° to the horizontal so that gravity will propel the visual field objects downwardly. Additionally, the ceiling need not be planar as shown, but may be shaped as desired.

FIG. **3** illustrates a near vertical façade or wall **24***a* with apertures **26***a* at the end of hollow ducts (not shown) leading from a hopper (not shown) containing a plurality of visual field objects **36**. The visual field objects are released from the apertures in the wall and fall in an arc as shown.

Hopper **16** is intended to hold a plurality of visual field objects that are to be used in producing abstract and manifest images within visual field **40**, as will be described below. Visual field objects that pass through the visual field are recirculated to the hopper to maintain a continuous supply of visual field objects in the hopper. Preferably, a mixing device (represented diagrammatically as feature **34** in FIG. **1**) will be provided within or connected to the hopper for keeping the visual field objects circulating within the hopper. Such movement helps maintain an even distribution of the objects across the top surface **19** of bottom panel **18** of the hopper to continuously provide the visual field objects the opportunity to engage apertures **22** without clogging. However, it must be understood that embodiments of the invention are not intended to be limited to any particular method of providing the field objects the opportunity to engage or exit at the apertures.

Mixer **34** may be any appropriate mixing device such as a conventional stirring-type device or vibratory-type device capable of keeping the visual field objects circulating across apertures **22**. An example of a stirring-type mixer that may be used is a device that has a motor **35** turning a central shaft **37** with one or more paddles **39** attached that push the spheres about as the shaft rotates. If the mixer is a vibratory mixer, it may be arranged to vibrate the hopper left/right, up/down, or randomly at a sufficient amplitude to keep the visual field objects circulating.

A plurality of hollow ducts **28** that are open at their respective top ends **30** and bottom ends **32** extend between apertures **22** in the bottom panel of the hopper and apertures **26** in the ceiling to deliver the visual field objects from the hopper to the apertures in the ceiling. The ducts preferably are long enough to allow two or more visual field objects to be collected in each duct. The longer the ducts, the more visual field objects can be collected in each duct, resulting in a greater flow rate of visual field objects from the bottom ends **32** of the ducts when the visual field objects are synchronously released.

In an alternate embodiment, panel **18** and ceiling **24** are also oriented horizontally, and holes **22** and **26** may be aligned with only a partial duct **28***a* running between them (FIG. **18**). Such a structural arrangement will permit visual field objects to fall vertically under the force of gravity between bottom panel **18** of the hopper and the ceiling while being confined in the duct during only part of their trajectory. Finally, some or all of ducts **28** optionally may also extend to below the bottom surface of the ceiling so that the visual field objects begin their fall from the duct ends at a location in the visual field space below the ceiling.

Ducts **28** may be any shape desired, although cylindrical ducts (as shown) are preferred. In all cases, the ducts must be large enough to permit free movement of the visual field objects through them. It is preferred that the ducts be only large enough to minimize friction where the field objects pass the duct inner surfaces to maximize the repeatability and accuracy of the movement of the visual field objects after they are released from the ducts in successive drop cycles. Ducts **28** may have a square, rectangular, triangular, or other polygonal cross-section. Apertures **22** and **26** should not interfere with passage of visual field objects through the ducts and preferably will have a size and shape corresponding to the cross-sectional shape of the ducts.

Ducts **28** each include a gating device **42** to control the intervals at which the visual field objects fall through each of the ducts to produce synchronous imagery. The higher the gating device is located on the duct, the straighter will be the trajectory of the visual field object as it exits the bottom of the duct. For example, for a 6.0 inch sphere, in a 6.1 inch diameter tubular duct, 6 inches above the ceiling height is sufficient to give a very repeatable and straight trajectory. The gating devices of each duct are controlled as explained below in such a way that the synchronous release of the plurality of visual field objects produces predetermined, desired abstract and manifest images in visual field **40**.

The gating devices may be located outside of the ducts with an operative member passing through a slot, bore or other opening in the duct wall. The gating devices may be solenoids positioned in such a way that when the solenoid current is off, the solenoid plunger extends through a duct bore slot or into the duct and when the appropriate current is provided to activate the solenoid, the solenoid plunger retracts into the solenoid, compressing a return spring. When the current is turned off, the spring decompresses, returning the plunger to its original position extending into the duct. The solenoids preferably will be pull-type and spring loaded although push type spring loaded solenoids can also be used. In fact, any electromechanical valve capable of blocking movement in the ducts can be used, so long as the state switch time is short enough.

This is illustrated, for example, in FIG. **4**A, where a cylindrical duct **28** is shown, partially cut-away to reveal a series of spherical visual field objects **36***a* resting atop one another within the duct. A single visual field object **36***b* falling downwardly in direction "A" appears in FIG. **4**A below the bottom edge **32** of the duct. A control bore **41** is located in the wall of the duct. The shape of the control bore will depend on the gating device used to release visual field objects **36***a*. For example, if the gating device is a spring loaded pull type solenoid **43**, then the bore may be a just large enough for the solenoid plunger **44** to move freely within the bore. When the solenoid is turned off, the solenoid plunger's spring **46** helps bias the plunger tip through the bore and into the duct. In this "off" configuration, the solenoid plunger prevents any spheres in the duct from being released. When the solenoid is activated, the plunger retracts from the duct, allowing one or multiple spheres to drop from the duct as a part of a drop cycle to produce a synchronous image. The number of spheres dropped depends on the on timing of the movement of the solenoid plunger.

Solenoid **43** is illustrated diagrammatically in FIGS. **4**A and **4**B with its plunger **44** projecting across the diameter of the duct and a spring **46** which maintains the plunger in an extended (blocking) position until the solenoid is activated. When the solenoid is activated the plunger is withdrawn into the body **48** of the solenoid and the spring is compressed. As shown in FIG. **4**B, a "C" clamp **49** is fitted to solenoid spring **46** where it abuts the outer surface of duct **28**. The distal tip of the solenoid plunger may be conical to help avoid undesirable interference with the visual field objects. While the solenoids (and plunger or other gating device) may be located at any desired position along the longitudinal axis of the ducts, it is currently generally preferred that it be located near the bottom ends **32** of the ducts. However, if it is desired to accelerate the visual field objects before they emerge from the ducts, the solenoids (and hence release point) may be located higher up on the duct, so long as there is sufficient room for at least one visual field object above the solenoid plunger. Indeed, different visual field objects may be dropped at different velocities by varying the release points in different ducts.

Solenoid **42** includes wires **50**A and **50**B which run from an electromagnet within the solenoid (not shown) to a solenoid power supply so that application of current to wires **50**A and **50**B to activate the solenoid will cause the plunger to be withdrawn from the duct, as described above. Thus, visual field objects **36***a* within hopper **16** which are moved about by mixer **34** so that they continuously fall through apertures **22** into ducts **28**, will be stored in the ducts and released periodically by powering solenoid **42** to withdraw the solenoid plunger and release one or more visual field objects before the plunger returns to its extended position. The more powerful the solenoid, the more powerful spring **48** can be, and the more powerful the solenoid/spring combination, the faster the on/off switching of the solenoid can be. Precise and rapid on/off switching and movement of the solenoid will produce optimal novel imagery in embodiments of the invention.

FIG. **5** shows an alternative embodiment of a gating device. In this figure, the gating device comprises a diagrammatically illustrated controllable motor **50** with a paddle wheel **52** mounted to its shaft **53**. The paddle wheel has a series of vanes **54***a*-**54***d* which extend through a slot-shaped opening **56** in the wall of duct **28**. When the paddle wheel is at rest with one of its paddles, e.g., vane **54***a*, projecting generally across the longitudinal axis of the duct, this vane will prevent release of the bottom most visual field object **36***a*. When the controllable motor is powered to rotate the paddles downwardly 90°, vane **54**B will release/move the bottom-most visual field object **36***c* while vane **54***c* is moved into place below the next visual field object **36***d*. Thus, the bottom-most visual field object will be released from the duct and movement of the next visual field object through the duct blocked by the next vane.

Other types of controllable release valves that can be used as gating devices, include butterfly valves **52***a* (FIG. **16***a*), partial ball valves **52***b* (FIG. **16***b*/**16***c*), and diaphragm valves.

In alternative embodiments, a set of secondary gating devices may be included. Such duplication of the gating devices may be used if the weight of the visual field objects is an issue or if the absolute precision of the dropping visual field objects is important as in instances where lighting effects as discussed below are to be maximized, etc.

Visual field objects **36** preferably will be received in a receptacle **60** of any desired shape. For example, the receptacle may be a cylindrical container as shown in FIG. **6** which is located below or within the visual field containing a fluid such as water or an appropriate oil **62** which will reduce bounce-back by the visual field objects, slow the rate of descent, and also reduce noise as they are received in the receptacle. If a clear-walled, fluid-filled receptacle **60** is used with an open receptacle top **64**, the visual field objects may be observed floating downward in the receptacle. In most embodiments, the visual field objects will be collected below the visual field and returned to the hopper through a recirculating unit **70**. For example, the bottom **65** of receptacle **60** may be tilted toward one edge so that the visual field objects roll to that edge where they are withdrawn from the receptacle by the recirculating unit which moves the visual field objects back into hopper **16**.

By whatever means the visual field objects are collected in the receptacle, they may be returned to the hopper by any appropriate recirculating unit which transports the objects upwardly to the hopper. For example, a screw conveyor **70***a* (FIG. **17***a*), a pneumatic conveyor, a chain conveyor, a bucket conveyor **70***b* (FIG. **17***b*), an auger conveyor, or a belt conveyor **70***c* (FIG. **17***c*) may be used.

In an elevator bucket-type recirculating system, a conveyor belt, with appropriately placed buckets on it, travels from the receptacle, picking up visual field objects as it moves through or past available already-dropped objects, continuously carrying and dumping the visual field objects that it picks up into the hopper in the upper section.

One or a series of launch pipes opening may be used to propel objects from a receptacle or other receiving area at the bottom of the visual field, one or several at a time. This is illustrated, for example, in FIG. **7** which constitutes another recirculating system. FIG. **7** includes a façade or ceiling **24***b* with a rectangular array of release apertures **26** generally centered in the ceiling and a rectangular array of larger return apertures **27** encircling the rectangular array of release apertures. A plurality of visual field objects **36** are shown falling downwardly from selected release apertures to form an abstract image in visual field **40**.

A receptacle platform **61** is positioned below the visual field. The receptacle platform includes a rectangular array of receptacle apertures **84** corresponding to the rectangular array of release apertures **26**. The receptacle platform also includes a rectangular array of launch apertures **22***a* encircling the array of receptacle apertures.

As the apparatus operates, visual field objects which traverse the visual field drop through the receptacle apertures and are collected and launched upwardly from the launch apertures as launched objects **36***f* that reach and pass through the receptacle apertures. The launched visual field objects are then collected in a hopper or other receptacle (not shown) and again dropped when desired through the release apertures.

One method for launching the visual field objects from the receptacle apertures is illustrated in FIG. **8**. This figure includes a gently inclined ramp **90** onto which visual field objects **36** that pass through the receptacle platform apertures are collected. The visual field objects are maintained in place on the ramp by a solenoid (or other appropriate) gating device **92**. The proximal end **94** of the ramp is located adjacent the distal end **98** of tube **96**. Tubes **96** are dimensioned slightly larger than the diameter of the visual field objects so that the visual field objects may move freely but uniformly through the tubes. A compressed air source such as a compressed air tank **101** is provided along with a compressed air release valve **102** at the proximal end **105** of tube **98**. Additionally, tubes **96** need not be vertically disposed, but rather may be angled to produce desired object trajectories. Indeed, the tubes may be mounted to x/y/z controllers to vary trajectories as the apparatus operates.

Thus, when it is appropriate to launch a visual field object from a receptacle aperture, solenoid gating device **92** is triggered to open, permitting one or more visual field objects to roll off of end **98** of the ramp into tube **96** and compressed air release valve **102** is opened at a time predetermined to correspond to the time at which the visual field object will reach the proximal end **104** of the tube. The released compressed air will propel the visual field object upwardly, through the corresponding launch aperture, across the visual field, and into a predetermined receptacle aperture in ceiling **24***b* (FIG. **7**). By properly positioning tubes **96** and precisely controlling the pressure and duration of the launch valve open time, the trajectory of the projected visual field objects will be predetermined and known. In this way, the visual field objects can be projected back into the hopper or other receptacle above the ceiling. Furthermore, the pattern of downwardly falling visual field objects and launched, returning visual field objects will add significant interest to the imagery.

Synchronized kinetic imagery system embodiments are driven by a control unit which controls the gating devices **42** to produce a continuous cycle of falling visual field objects. The program may also drive the recirculating system and, if a compressed air launch is used, the software may control the compressed air source in the launch pipes. An off-the-shelf program shelf program/controller, such as Unitronics Unistream (http://www.unitronics.com/plc-hmi/unistream) may be used for this purpose.

Alternatively, a conventional computer/microprocessor may be programmed using known programming techniques to carry out the process illustrated in FIG. **9**. This figure shows a control unit **110** which is wired to a gating device **112** such as solenoid **43** or paddlewheel **52**. The computer/microprocessor will control the on/off operation (**114**, **115**) of gating devices associated with each of the ceiling apertures to release and hold (**119**, **121**) the visual field objects when required to produce a desired image.

In order to keep the system supplied with visual field objects, computer/microprocessor **110** will be programmed to turn the hopper mixer on and off (**123**) as necessary to keep the visual field objects advancing within the apparatus.

Finally, where an optional launch system as described above is used, computer/microprocessor **110** will drive a pneumatic launch control **124**, turning it on or off (**126**, **128**) for releasing visual field objects and releasing compressed air at the appropriate times to launch or hold the objects (**130**, **132**).

A cycle of operation of the apparatus is illustrated in the following matrix implemented by a computer program which triggers gating devices **42** in selected ducts **28** in a linear three-dimensional matrix below. In this matrix ducts above apertures **26**A-**26**K of FIG. **1** are listed across the top of the matrix and, release times t_1-t_6 are listed in the column at the left. Thus, initially the computer or microprocessor will open the gating devices in ducts **26**A-**26**K at time t_1. At time t_2 the gating devices in ducts above apertures **26**B and **26**J will be opened, releasing the bottom-most visual field objects in those ducts. At time t_3 the same will occur in ducts above apertures **26**C and **26**I, at time t_4 the same will occur in ducts above apertures **26**D and **26**H, at time t_5 the same will occur with the gating devices in ducts above apertures **26**E and **26**G. At time t_6 the gating device in the duct above apertures **26**F will be opened releasing the bottom-most visual field object in that duct. This process will continuously repeat as successive visual field objects are released from the ducts.

Thus, the visual field objects released at time t_1 will be the first to reach the bottom of visual field **40** forming the base of a triangle. As the drop cycle proceeds the visual field objects released at time t_2 will arrive just above the first row of visual field objects to begin constructing the sides of a triangle, as depicted in FIG. **10**A.

may be made of a ferromagnetic material such as iron, nickel, cobalt, or appropriate rare earth metal alloys and the solenoids (FIGS. **4**A, **4**B) be replaced with gating devices in the form of electro magnets **140** that are normally in an activated state. When an electromagnet in a particular duct is de-activated, a ferromagnetic visual field object will be released toward the ceiling aperture below, followed by the activation of the electromagnet to trap the next following visual field object.

FIG. **11** illustrates yet another embodiment in which ducts are not used. Rather, visual field objects **36** are supported by open, gently inclined laterally confining structures such as ramps **72**. The distal ends **76** of these ramps are aligned with tubes or other conduits **74** which open at apertures **26** in ceiling **24**. Alternatively, the distal ends **76** of the rails may be aligned with the apertures, eliminating the conduits. A gating device such as a ramp solenoid **75** may be positioned at or near the distal ends **76** of the ramps to release the visual field objects so that they roll down the ramps and pass through the desired apertures when triggered by the system, to produce a desired abstract or manifest image. If it is desired to accelerate the drop of the visual field object, the gating device may be positioned higher up on the ramp so that the visual field object will pick up speed before it passes through the ceiling aperture.

	26A	26B	26C	26D	26E	26F	26G	26H	26I	26J	26K
t_1	X	X	X	X	X	X	X	X	X	X	X
t_2		X								X	
t_3			X						X		
t_4				X				X			
t_5					X		X				
t_6						X					

A three-dimensional shape may be generated as described above, by triggering gating devices **42** in selected ducts of a series of rows of ducts.

Since each solenoid is independently controlled by the program, a virtually infinite number of image patterns may be generated in this way including abstract images and manifest images. For example, letters of the alphabet may be displayed either sequentially or simultaneously, optionally along with logos, to convey messages, such as advertising messages. This is illustrated in FIGS. **10**B and **10**C, which illustrate the sequential display of first the well-known Nike logo followed by the "N" of the Nike trademark, which in turn will be followed by the "I", "K", and "E" (not shown) to generate an advertising image for Nike.

While the gating devices are operated in this example to release only one visual field object at a time from each of the designated ducts, multiple objects may be released in this example at one time from the apertures or the time of release of objects in the same row may be staggered to create a triangular image that rocks back and forth as it progresses downwardly within a visual field. It should be noted that visual field objects released one after another in the same on/off drop cycle will remain visually "attached" to each other because they all begin their descent due to gravity together. This stands in contrast to successive visual field objects released by successive on/off cycles where each visual field object starts its descent at a different time, to produce spreading of the visual field objects as they descend.

If more precision in the timing of the drops is desired, if the apparatus needs to be silent, or if it is desired to provide an entire apparatus with no moving parts, a structure as in FIG. **14** may be provided. In this structure, visual field objects **36***e*

Lighting elements may be integrated into any or all of the ceiling apertures and/or any or all of the ducts. For example, as illustrated in FIG. **13**, at an appropriate desired distance and position above selected ceiling apertures **26**, a combination of a light source **134** and either a light pipe or a lens **136** with the appropriate focal length may be placed. In this arrangement, the light **138** exiting the light pipe or the lens will be effectively collimated. Thus, if the visual field objects are clear or translucent and are directed under the collimated light as they drop, the collimated light beam will have the effect of illuminating the visual field object and may also give the object the appearance of being a light source itself. When the gating device is momentarily opened to permit a visual field object to fall, the object will remain illuminated with approximately the same intensity (due to the collimated source) as it falls through the visual field. Also, multiple light sources may be used above each aperture, with computer control of the on/off timing, intensity and/or color of each light source to control over the intensity, blinking or color of each object as it drops. Varying colors may be provided, for example, using an array of colored LED lights.

In a similar fashion, this lighting approach may be applied to visual field objects launched from launch pipes where a combination of a light source and either a light pipe or a lens with the appropriate focal length may be placed to direct light into the launch pipes. Finally, the lighting effect may be further enhanced by placing additional reflecting surfaces on or in the visual field objects.

A unique aspect of embodiments of this apparatus is its ability to exploit the principle of superposition in a receptacle partially filled with a fluid. This principle states that the amplitudes of separate waves add (as long as the waves are in their linear region) when they pass through each other. The precision drop control of the visual field objects combined with the visual field objects' unique ability to create very regular circular wavefronts expanding from the pattern object/fluid impact site is key to these embodiments.

For example, if a visual field object is dropped from hole **200** of FIG. **12** after the object strikes the fluid the wavefront of the circular wave expanding from the impact site will spread in all directions, including directly towards the center, directly below where hole **202** of FIG. **12** is located, like the effect of an expanding circular wave seen when a pebble drops into a pool of water. If at precisely the same time, visual field objects are dropped from holes **200** and **204** because it is visual field objects that are dropping and because the visual field objects being dropped are the same size, the wavefront expanding from the impact site of object **200** will look like the wavefront expanding from the impact site of object **204**, with both wavefronts having the same amplitude. These two wavefronts will pass through each other in the center of the circle represented by apertures **206-249** directly below hole **202**. And, for a split second the height of the fluid directly below hole **202** will be slightly higher than normal, due to the addition of these two waves as they pass through each other. But because there are only two waves involved, and the height of each of the two waves is not great by the time they reach each other below hole **202**, the effect may not be very noticeable. However, if visual field objects **206-249** are all dropped at the same time, each wavefront is the same as in the case where only one or two visual field objects were dropped, but now when all 44 wavefronts pass through each other below hole **202**, the result is quite dramatic. Because, while the amplitude of any one of the waves is not great, for that moment when they all pass through each other below hole **202**, **44** small waves add together to create one large spike of fluid, substantially higher than the normal height of the fluid at that point. This effect can be maximized by altering the viscosity of the fluid in the pool.

In another embodiment, by timing the drops of the visual field objects, a resonance condition can be established in a fluid pool A resonance condition in a fluid pool occurs when a wave, call it Wave I, traveling in one direction is reinforced (its amplitude made larger) by another wave, call it Wave II, whose location, direction, and speed are the same as Wave I. If additional waves are introduced in such a way that their location, direction, and speed also reinforce Wave I, then the amplitude of Wave I will continue to increase (so long as the reinforced wave remains linear), creating a resonance condition. This resonance condition can be created in the fluid pool of an embodiment with the precision dropping of its visual field objects.

Consider holes **249-264** and **265-279** in FIG. **12**. If a visual field object is dropped from each of holes **249-264** at the same time, then after impact with the fluid, the resulting waves will create a circular wave concentric to and in the direction of holes **265-279**. This wave (Wave "III") will travel across the pool at a given speed. Now, at some time after the visual field objects have dropped from holes **249-264**, objects are dropped from each of the holes **265-279**, all at the same time. If this drop time is properly timed, then the visual field objects dropped from holes **265-279** can be made to land directly on top of Wave IV, thereby reinforcing it. Now Wave IV is slightly larger than it was originally and headed toward and into the right wall of the pool enclosure. If the walls of the pool are inelastic, then Wave IV will reflect off the wall (remaining parallel to holes **249-264** and **265-279**) and continue back towards the left wall. If, as Wave III continues, visual field objects continue to drop, at precisely coordinated times from holes **265-279-249-264**, then a resonance condition will be created, where Wave III is repeatedly reinforced, leading to a large wave traveling back and forth across the fluid pool. This result will be unexpected by viewers of embodiments of the system because the plane waves created by any individual line drop are relatively small in amplitude, and it is not apparent that a large amplitude wave can be created from these initial small amplitude waves.

Finally, music can be provided coordinated with dropping (or launch returning) visual field objects to make a viewer's experience an auditory as well as a visual experience. For example, a popular song could be played during a drop sequence preferably with a rhythm corresponding to the dropping objects, adding to the viewer experience. Alternatively, a piece of music could be written specifically for a drop sequence, where different tones/notes correspond to different drop holes, release times, or fall durations. In yet another alternative, a sound generator could be used to produce certain sounds corresponding to one or more events in the operation of the apparatus, such as an object emerging from a ceiling aperture, an object traversing the visual field, or an object reaching the bottom of the visual field.

While the above disclosure demonstrates selected embodiments of the system, those skilled in the art will understand there are many parameters of the apparatus that can be changed while remaining within the spirit of the disclosure. In view of the many possible embodiments to which the principles of the present discussion may be applied, it should be recognized that the embodiments described herein with respect to the figures are meant to be illustrative only and should not be taken as limiting the scope of the claims. Therefore, apparatus as described herein contemplate all such embodiments as may come within the scope of the following claims and equivalents thereof.

The apparatus described herein may include a processor, a memory for storing program data to be executed by the processor, a permanent storage such as a disk drive, a communications port for handling communications with external devices, and user interface devices, including a display, touch panel, keys, buttons, etc. When software is involved, the software may be stored as program instructions or computer readable code executable by the processor on a non-transitory computer-readable media such as magnetic storage media (e.g., magnetic tapes, hard disks, floppy disks), optical recording media (e.g., CD-ROMs, Digital Versatile Discs (DVDs), etc.), and solid state memory (e.g., random-access memory (RAM), read-only memory (ROM), static random-access memory (SRAM), electrically erasable programmable read-only memory (EEPROM), flash memory, thumb drives, etc.). The computer readable recording media may also be distributed over network coupled computer systems so that the computer readable code is stored and executed in a distributed fashion. This computer readable recording media may be read by the computer, stored in the memory, and executed by the processor.

The disclosed embodiments may be described in terms of various processing steps which may be realized by any number of hardware and/or software components configured to perform as described. For example, the disclosed embodiments may employ various integrated circuit components, e.g., memory elements, processing elements, logic elements, look-up tables, and the like, which may carry out a variety of functions under the control of one or more microprocessors or other control devices. Similarly, where the elements of the disclosed embodiments are implemented using software programming or software elements, the disclosed embodiments may be implemented with any programming or scripting language such as C, C++, JAVA®, assembler, or the like, with the various algorithms being implemented with any combination of data structures, objects, processes, routines or other programming elements. Functional aspects may be implemented in algorithms that execute on one or more processors. Furthermore, the disclosed embodiments may employ any number of conventional techniques for electronics configuration, signal processing and/or control, data processing and the like. Finally, the steps of all methods described herein may be performed in any suitable order unless otherwise indicated herein or otherwise clearly contradicted by context.

For the sake of brevity, conventional electronics, control systems, software development and other functional aspects of the systems (and components of the individual operating components of the systems) may not be described in detail. Furthermore, where connecting lines are shown, the lines are intended to represent exemplary functional relationships and/or physical or logical couplings between the various elements. It should be noted that many alternative or additional functional relationships, physical connections or logical connections may be present in a practical device. The words "mechanism", "element", "unit", "structure", "means", "device", "controller", and "construction" are used broadly and are not limited to mechanical or physical embodiments, but may include software routines in conjunction with processors, etc.

The use of the terms "a" and "an" and "the" and similar referents in the context of describing the embodiments of the invention are to be construed to cover both the singular and the plural, unless otherwise indicated herein or clearly contradicted by context. Recitation of ranges of values herein are merely intended to serve as a shorthand method of referring individually to each separate value falling within the range, unless otherwise indicated herein, and each separate value is incorporated into the specification as if it were individually recited herein. All methods described herein can be performed in any suitable order unless otherwise indicated or otherwise clearly contradicted by context. The use of any and all examples, or exemplary language (e.g., "such as") provided herein, is intended merely to better illustrate the invention and does not pose a limitation on the scope of the invention unless otherwise claimed. Finally, it should be understood that the illustrated embodiments are exemplary only, and should not be taken as limiting the scope of the invention.

Table of Reference Characters

Character No.	Character Name
10	falling pattern imagery system
12	upper section of imagery system
14	lower section of imagery system
16	hopper
18	bottom panel of hopper
19	top surface of bottom panel of hopper
20	sidewalls of hopper
21	top of hopper
22	apertures in bottom panel of hopper
22a	launch apertures
24	facade or ceiling
24a	near vertical facade
24b	facade or ceiling for receiving launched objects
25	central aperture
26	apertures in facade or ceiling
26a-26k	selected apertures in ceiling
27	return apertures
27A-27C	concentric circles of apertures
28	hollow ducts

-continued

Table of Reference Characters

Character No.	Character Name
30	top ends of hollow ducts
31	triangular ceiling aperture configuration
32	bottom ends of hollow ducts
33	apertures of triangular ceiling configuration
34	mixer device
35	mixer device motor
36	visual field object
36a	visual field objects at rest in duct
36b	released and falling visual field object
36c	bottommost visual field object
36d	next visual field object
36e	ferromagnetic visual field object
36f	launched visual field object
A	direction of falling single field object
37a	apertures of rectangular ceiling configuration
38	bottom edge of ducts
39	paddles attached to motor shaft
40	visual field of imagery system
41	control bore
42	gating device
43	solenoid
44	solenoid plunger
45	rectangular ceiling aperture configuration
46	solenoid spring
48	body of solenoid
49	solenoid "C" clamp
50	motor
50A/50B	solenoid wires
52	paddle wheel
53	shaft of motor
54a-54d	paddle wheel vanes
56	duct wall opening
60	receptacle
61	receptacle platform
62	fluid
64	top receptacle
65	bottom of receptacle
66	receptacle cover
68	apertures in receptacle cover
70	recirculating unit
72	ramps
74	tubes
76	distal ends
78	ramp solenoid
80	rectangular array of apertures
82	receptacle platform
84	receptacle apertures
86	launch apertures
90	Ramp of launch apparatus
92	Launch apparatus gating device
94	Proximal end of launch device ramp
96	Launch device tube
98	Distal end of launch device tube
100	computer/microprocessor
101	compressed air tank
102	release valve
104	gating device "on" step
105	proximal end of launch tubes
106	gating device "off" step
108	visual field object release step
110	computer/microprocessor/microcontroller
112	hopper mixer on/off control step
113	solenoid/paddle wheel motor control
114	optional launch control step
114, 115	on/off conditions of motor control
116	pressurized air "on" step
118	pressurized air "off" step
120	launch return step
119, 121	objects released and objects held
122	launch resist step
123	hopper mixer control
124	pneumatic launch control
126, 128	on/off conditions of launch control
130, 132	objects released and objects held
134	light source

-continued

Table of Reference Characters

Character No.	Character Name
136	lens (may be light pipe)
138	collimated light
140	electromagnet

What is claimed is:

1. An apparatus for dropping multiple visual field objects into a visual field to create imagery comprising:
- an upper section, a lower section, and a visual field disposed between the upper and lower sections;
- a container for receiving and holding visual field objects disposed in the upper section having a plurality of apertures distributed across its bottom;
- a façade having a plurality of apertures in alignment with the apertures distributed across the container bottom;
- a plurality of hollow ducts extending between the container apertures and the façade apertures for conveying the visual field objects from the container to the façade apertures;
- gating devices located in the ducts for releasing the visual field objects from the ducts to produce imagery in the visual field;
- a receptacle for receiving the visual field objects after they pass through the visual field;
- a recirculating unit for returning visual field objects from the receptacle to the container disposed in the upper section; and
- a control unit to operate the gating devices.

2. The apparatus of claim **1** in which the imagery is chosen from the group consisting of stationary imagery, dynamic imagery, abstract imagery, and manifest imagery.

3. The apparatus of claim **1** in which the visual field objects are chosen from the group consisting of spheres, cubes, cylinders, pyramids, toruses, hemispheres, prisms, star-shapes, pill shapes and cone shapes.

4. The apparatus of claim **1** in which the visual field objects are made of a material chosen from the group consisting of metal, plastic, wood, rubber, glass, and foam.

5. The apparatus of claim **1** in which the visual field objects are made of a ferromagnetic material.

6. The apparatus of claim **1** in which the images are in linear three-dimensional form or full three-dimensional form.

7. The apparatus of claim **1** in which the container apertures are arranged in a configuration chosen from the group consisting of random configurations, geometric shapes, regular or irregular matrices, and outlines of visual objects.

8. The apparatus of claim **1** in which the façade is at any desired angle greater than 90° from the vertical.

9. The apparatus of claim **1** including a mixing device for keeping the visual field objects circulating within the container.

10. The apparatus of claim **9** in which the mixing device is a stirring-type device or a vibratory-type device.

11. The apparatus of claim **1** in which the ducts extend through the façade.

12. The apparatus of claim **1** in which the gating devices are chosen from the group consisting of solenoids, paddle wheels mounted to controllable motors, butterfly valves, partial ball valves, and magnetic valves.

13. The apparatus of claim **1** in which second gating devices are mounted in the ducts.

14. The apparatus of claim **1** in which the receptacle contains a fluid.

15. The apparatus of claim **1** in which the recirculating unit is chosen from the group consisting of screw conveyors, belt conveyors, and bucket conveyors.

16. The apparatus of claim **1** in which the receptacle includes apertures for receiving visual field objects that pass through the visual field and launchers for propelling the visual field objects back through the visual field to the container disposed in the upper section.

17. The apparatus of claim **16** in which the launcher comprises an inclined ramp for collecting visual field objects, a gating device for controlling the movement of the visual field objects from the ramp, a tube for receiving visual field objects released from the ramp, a compressed air source, and a compressed air release valve for propelling visual field objects from the tube.

18. The apparatus of claim **1** in which the hollow ducts do not extend the entire distance between the container apertures and the façade apertures.

19. An apparatus for dropping multiple objects into a visual field to create imagery comprising:
- an upper section, a lower section, and a visual field disposed between the upper and lower sections;
- a container for receiving and holding visual field objects disposed in the upper section having a plurality of apertures distributed across its bottom;
- a façade having a plurality of apertures in alignment with the apertures distributed across the container bottom;
- a plurality of hollow ducts extending between the container apertures and the façade apertures for conveying visual field objects from the container to the façade apertures;
- gating devices located in the ducts for releasing the visual field objects from the ducts to produce imagery in the visual field;
- a receptacle for receiving the visual field objects after they pass through the visual field, the receptacle having apertures for receiving visual field objects received in the receptacle and launchers for propelling the visual field objects back through the visual field to the container disposed in the upper section; and
- a control unit to operate the gating devices and the launchers to produce the imagery and to propel the visual field objects to the container disposed in the upper section.

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